Nature of non-radiation and radiation of the orbital electron

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This article was published like chapter 7 in the Leonov's book: Quantum Energetics. Volume 1. Theory of Superunification. Cambridge International Science Publishing, 2010, pp. 512-582. The atomic nucleus is located inside the gravitational well which is created by the mass of the nucleus. The presence of a gravitational well around an atomic nucleus was never taken into account in theory. Ignorance of this fact created many problems in describing and explaining the behavior of the orbital electron. The fact that the orbital electron rotates inside the gravitational well of the atomic nucleus was first established in the theory of Superunification. When an orbital electron falls on an atomic nucleus inside a gravitational well, its gravitational energy decreases as much as its electric energy increases. In this case, the total energy of the orbital electron remains constant regardless of the complexity of its trajectory. Therefore, the orbital electron does not emit photons, no matter how complex its trajectory inside the electron cloud. An orbital electron emits a photon at the moment of transition from one complex trajectory to another complex trajectory.

In this book, the reasons for the non-radiation radiation of the orbital electron in the composition of the atom are examined for the first time using the classic approach. It is established that the atom is an energy-balanced system capable of stabilising the mass of the orbital electron in the entire speed range, including relativistic speed. The radiation of the orbital electron takes place in the range of relativistic speeds as a result of the mass defect of the electron on the atom nucleus and is associated with the effect on the electron of threshold (critical) accelerations, determining the discrete nature of radiation.

7.1. Introduction

From the viewpoint of classic physics, the behavior of the orbital electron in the composition of the atom is anomalous because it completely contradicts the Maxwell electrodynamics in which the orbital electron, moving with acceleration on a complicated trajectory, including the stationary set of orbits in the form of an electronic cloud, surrounding the atom nucleus, should continuously emit electromagnetic waves. For example, the orbital electron in the composition of a proton nucleus of the hydrogen atom making a turn along the greatly elongated stationary orbit, continuously changes the strength of the electrical field **E** with time *t*, determined by the change of the distance **r** between the electron and the proton. In accordance with the laws of Maxwell electrodynamics, the orbital electron should continuously emit energy and, in the final analysis, should fall on the atom nucleus [1].

However, in reality, the situation is paradoxical. The electron on the stationary orbit does not emit electromagnetic energy and does not fall on the atom nucleus. The Maxwell electrodynamics, whose fundamental nature was not doubted, ceased to operate in the structure of the atom. The reasons for the anomalous behaviour of the orbital electron could not be explained. In addition to this, it was established that the observed radiation of the orbital electron is not associated with the nature of the trajectory of the orbit and is not continuous. It was found that the electron emits energy in portions (photons), and not continuously, and only at the moment of transition from the excited state to a lower orbit. The transition of the electron at the lower orbit increases the energy of electrostatic interaction of the electron and the atom nucleus with simultaneous emission of a photon. It is shown in this book that the energy balance is not compensated by a decrease of the kinetic energy of the electron because the classic calculation method cannot be used for the atom. Classic physics faces serious problems when describing the behaviour of the orbital electron and its radiation, and attempts have been made to solve these problems in quantum physics.

The formation of quantum physics is associated with the introduction of the wave function when the behaviour of the orbital electron is characterised by its probability state, represented by the electronic cloud. In fact, the orbit of the electron in the classic concept of the trajectory has disappeared as such from quantum theory. In addition, in accordance with the Heisenberg uncertainty principle, it was no longer possible to determine simultaneously the pulse and coordinates of the orbital electron because it was not possible to define concretely the orbit of the electron in the classic concept. At least, the previously described concept of the behaviour of the orbital electron has been accepted in modern physics and represents the basis of the quantum theory of radiation and non-radiation of the orbital electron in the composition of the atom. However, the question is how long can the uncertainty principle hold and in which direction should quantum theory develop?

The discovery of the space-time quantum (quanton) and of the superstrong electromagnetic interaction (SEI) has made it possible to return the deterministic base to the quantum theory and describe the behaviour of the elementary particles on the basis of the classic concept, treating their quantised structure as open quantum-mechanics systems [1–4]. This relates to the behaviour of the orbital electron in the composition of the atom, assuming that the atom is an open quantum mechanics system with the unique properties and the previously unknown parameters, enabling the orbital electron to emit photons or not emit at all, in contrast to the laws of classic electrodynamics. For modern quantum theory, the reasons for this phenomenon remained unknown up to the discovery of the space-time quantum (quanton) and the superstrong electromagnetic interaction (SEI).

It is well known that the new fundamental discoveries enable large additions to be made to the theory of radiation and non-radiation of the orbital electron in the composition of the atom, primarily the reasons for the phenomenon. In previous chapters, we explained the quantum theory of Maxwell electrodynamics in vacuum and the electromagnetic structure of vacuum [1], the quantum theory of gravitation, including elementary particles [2], nature and structure of the photon [3], the quantum structure of the discrete electron [4] and the quantised structure of the nucleons (chapter 5) [5].

In addition to the theory of nucleon interactions, it is also important to consider the zones of anti-gravitation repulsion of the alternating shell of the nucleons at distances shorter than the distance of the effect of nuclear forces. These are important in analysis of the stability of the shell of the nucleons when the forces of anti-gravitational repulsion of the monopole charges in the structure of the shell prevent the shell from collapse. In the structure of the atom, the anti-gravitational repulsion forces act against nuclear forces as forces of electrostatic attraction of the monopoles ensuring nucleus stability. The zones of anti-gravitational repulsion have been described in detail in [14] on the example of the discrete structure of the electron, treating the electron as a complicated quantum particle with its structure including the monopole electrical charge and the quantons of the medium, forming in the quantised medium several characteristic zones, including the zone of anti-gravitational repulsion.

The problem of radiation and non-radiation of the orbital electron in the composition of the atom is permanently linked with the discrete structure of the electron, the photon and the nucleons, and also with the new theoretical concepts presented in the theory of the elastic quantised medium (EQM) and the theory of Superintegration as a result of new fundamental discoveries of the quanton and the SEI [1–5].

Naturally, the theory of Superintegration of the fundamental interactions could not be ignored in unification of the principal relativity in the quantum theory, showing that the principal relativity is the fundamental property of the quantised space-time (elastic quantised medium). In particular, because of the quantised structure of the orbital electron in the composition of the atom as an open quantum mechanics systems, it has become possible to examine the reasons for photon radiation and non-radiation of the orbital electron. Undoubtedly, the primary position in this investigation is occupied by the fact that the two-rotor structure of the photon, as a relativistic wave particle, starts to form at speeds close to the speed of light [1–4]. This imposes restrictions on the Heisenberg uncertainty principle because at the moment of emission the orbital electron should have the speed close to the speed of light in the immediate vicinity of the atom nucleus. This condition makes it possible to define more accurately the coordinate of the electron and its momentum at the moment of photon emission. In detailed analysis of the dynamics of the orbital electron in the composition of the atom the very principle of uncertainty can be eliminated from quantum theory.

The attempts for understanding the behaviour of the orbital electron were made for the first time when analysing the circular orbit of the electron in the Bohr atom and subsequently the elliptical Zommerfeld trajectories on the example of the simplest hydrogen atom [6]. However, the reasons for the radiation and non-radiation of the orbital electron were not explained by the Bohr atom model. This was regarded as an impetus by Bohr to postulate the quantum state of the electron in the composition of the atom, accepting the discrete levels of the atom energy and the radiation energy of the atom as the difference of the concrete state. Regardless of the agreement in the results of the calculations in the simplest cases, the restricted nature of the mathematical apparatus based on the Bohr atom was evident. Further development of the quantum theory of the atom is associated with the introduction of the wave function which replaced the actual orbits of the electron in the composition of the atom by the electronic probability cloud. Thus, the quantum (wave) mechanics derived from the analysis the electron orbit as a physical reality, replacing it by the probability of the orbital electron (or an electron ensemble) being in the composition of the atom [7].

Undoubtedly, successes in the wave mechanics and calculation mathematical apparatus obtained on the basis of the statistical wave function, as now also shown in the Superintegration theory, were determined by the wave nature of all the elementary particles, being the integral part of the quantised space-time. Consequently, it was possible to derive analytically for the first time the wave equation of the electron in the form of the differential wave equation of the second order in partial derivatives on the basis of changes of the quantum density of the medium with time during movement of the electron [4]. The orbital electron is a quantised particle-wave with a discrete structure governed by the principle of the corpuscular wave dualism. In particular, the modification of the wave equation of not only the electron but of any elementary particle having a mass represents the basis of the wave function as a differential equation of the second order in partial derivatives.

The physicists know quite well that Einstein did not accept the statistical nature of the wave function ('God does not play dice') and that he was convinced that the quantum theory, like classic physics, should be based on the deterministic basis. 'It appears to be highly likely that sometimes in future improved quantum mechanics will be proposed with the return to the causality and justification of the Einstein viewpoint' – these are the words by the well-known theoretical physicist Paul Dirac in characterising the future of quantum theory [8]. The discovery of the space-time quantum (quanton) returns to physics the causality of understanding quantum phenomena showing that all the elementary particles are complicated quantum objects, not only elementary objects as indicated by their name [1–5].

It should be mentioned that as we penetrate deeper into the quantised medium, the energy concentration we must face becomes greater and greater. Naturally, the energy of the quantised medium determines the energy of the atom and of the atom nucleus, determining its discrete structure and the discrete structure of the electron as an integral part of the quantised medium. In particular, the continuity of the electron and of the quantised medium justifies the principle of corpuscular-wave dualism of the particle in the medium. The observed fraction of the radiation energy of the electron in this case is only a very small 'tip of the iceberg', and the main part of the electron energy is hidden in the abyss of the quantised medium and does not show itself directly in exchange processes of photon radiation but influences these processes [4].

The discrete quantised structure of the electron determines the behaviour of the orbital electron and helps to determine the reasons for its stability in the composition of the atom when there is no electron emission. In this case, we can concretise the state of the atom at the moment of emission of the orbital electron. The electron in the quantised medium should be regarded as a discrete particle capable of energy changes and exchange, both continuous on a complicated orbit and a jump-like at the moment of emission or absorption of radiation.

The history of quantum considerations with respect to the structure of matter started with the determination by Planck of the discrete nature of electromagnetic emission of the orbital electron in the composition of the atom:

$$W = \hbar \nu \tag{7.1}$$

Here W is the radiation energy, J; $\hbar = 1.05 \cdot 10^{-34}$ J is the Planck constant, ν is radiation energy, s^{-1}, Hz.

As regards the Bohr atom model, equation (7.1) was slightly changed. The energy of emission of the photon by the orbital electron is determined by the difference of the electron energies ΔW, for example, $W_1 - W_2$, where W_1 and W_2 is the electron energy in the first and second Bohr orbits, respectively

$$\Delta W = W_1 - W_2 = \hbar\nu = \Delta m_e C_0^2 \tag{7.2}$$

Equation (7.2) includes the mass defect Δm_e of the orbital electron and the gravitational potential C_0^2 of the quantised medium, whose introduction is already linked with the theory of EQM. Previously, the square of the speed of light c^2 [1–4] was used instead of the gravitational potential C_0^2 in (7.2).

However, even taking into account the Zommerfeld corrections of the circular Bohr orbits to elliptical orbits, the Bohr atom theory does not make it possible to calculate exactly the stationary space of the orbital electron. Situated on the greatly elongated elliptical orbit, the electron is capable of coming very close to the atomic nucleus, in fact falling on the nucleus, and changing in a very wide range of the energy of electrical interaction between the electron and the nucleus. As already mentioned, the electron does not emit in this paradoxic case, regardless of the resultant contradictions with Maxwell electrodynamics where the variation of the electrical field should generate electromagnetic radiation [6, 10].

Abandoning the further development of the Bohr atom model, physics also rejected the classic approaches in quantum theory when the understandable physical models and considerations were replaced by purely mathematical methods of processing the experimental results, using probability approaches. Almost simultaneously, Heisenberg and Schrödinger proposed two calculation models: matrix and statistical [1]. Since the parameters of the atom were not known, Heisenberg proposed to express the state of the orbital electron by a matrix, with computations of the matrix yielding the discrete parameters of the system corresponding to radiation. In fact, this was a purely mathematical approximation which did not make it possible to understand the reasons for the phenomenon. The statistical model of Schrödinger proved to be more universal, although of the same type. In this model, the state of the atom is described by a wave function ψ (probability amplitude) of the spatial coordinates (x, y, z) and time t

$$\psi(x, y, z, t) \tag{7.3}$$

The wave function (7.3) has no physical meaning but the square of its modulus $|\psi(x, y, z, t)|^2$ determines the probability of the particle being at time t in the appropriate coordinates (x, y, z), for example, in the elementary volume dV. Consequently, integrating $|\psi(x, y, z, t)|^2$ throughout the entire volume of the atom, the wave function (7. 3) should be satisfied by the unit probability, determining the presence of the orbital electron in the composition of the atom

$$\int_V |\psi(x,y,z,t)|^2 dV = 1 \qquad (7.4)$$

Finally, the orbits of the atom disappeared from the wave mechanics and converted to a probability cloud (7.4) of the negatively charged matter consisting of orbital electrons. For the orbital electron to fall on the atom nucleus, the calculated probability of the orbital electron (7.4) being in the subsurface volume of the atom nucleus is assumed to be equal to 0.

Regardless of the fact that the physical meaning aalso disappeared when explaining the state of the atom, the successes of the calculation procedures of wave mechanics proved to be real, including case when solving the problems of many particles (solids) in atomic physics. The reality of the electron orbits and the presence of the wave properties of the particles were not so important. On the other hand, the application of only probability methods in the investigations of the state of the atom is an indication of not knowing the nature of physical phenomena taking place inside the atom. The statistical nature of the calculation facilities of the wave mechanics has transformed the atom into a 'black box' whose internal structure was not investigated, and only external manifestation of its properties in the form of the radiation spectrum could be processed mathematically.

Naturally, the phenomenological nature of the probability method of investigation, regardless of significant successes of wave mechanics, has not solved the main problem of the physics of elementary particles and the atomic nucleus. The nature of the nuclear forces was not known prior to the development of the EQM and the theory of the unified electromagnetic field, and the structure of its main elementary particles was not discovered: the electron, positron, proton, neutron, electron neutrino, photon. New fundamental discoveries have made it possible in quantum theory to move basically from the plurality model of the classic models of investigations, ending the dispute between Einstein and Bohr regarding the determinism of the quantum theory in favour of Einstein [12]. New discoveries made it possible, together with the introduction of the quantum of the space-time (quanton), to determine the quantised discrete nature of not only the radiation quantum but also of all elementary particles, including the orbital electron. In quantum theory it became possible to transfer from the phenomenological probability in description of the behaviour of elementary particles to the deterministic understanding of their nature.

What are the new features brought to the theory of radiation and non-radiation of the orbital electron by the theory of EQM and Superintegration? Below, we list only the new assumptions which were previously not considered in the behaviour of the orbital electron in the composition of the atom:

1. The presence of the gravitational potential well around the atomic nucleus, with the orbital electron rotating inside the well. An increase of the electrical energy of the electron–nucleus system observed when the electron and the nucleus come together is compensated by the equivalent decrease of the gravitational energy of the system inside the gravitational well, defining the energy of the atom in the non-excited state as a constant and preventing the orbital electron from emitting energy [9].
2. The complicated structure of the alternating shell of the nucleon in the composition of the atomic nucleus is characterised by the presence of the zones of gravitational attraction and anti-gravitational repulsion. On approach to the proton, the configuration of its electrical field changes. The radial electrical field of the non-compensated electrical charge with the positive polarity of the proton changes to the tangential electrical field of its alternating shell in the vicinity of the surface of the nucleus [5].
3. The presence of the quantised structure in the orbital electron as an open quantum-mechanics system inside the quantised medium permits changes of the energy state of the electron as a result of the mass defect which is the only reason for radiation of the photon. In this case, it is necessary to take into account the presence in the electron of the zone of anti-gravitational repulsion which in interaction with the identical zones of the shells of the nucleons in the composition of the atomic nucleus does not allow the electron to fall on the nucleus [4].
4. Finally, it has been established that the two-rotor structure of the photon can form only in the region of relativistic speeds [3]. This means that the orbital electron in the composition of the atom at the moment of emission of the photon should reach the speed close to the speed of light. As shown by calculations, this is possible only in the immediate vicinity of the atomic nucleus (in fact, in the very nucleus): the effect of the centrifugal force and critical acceleration makes the electron to lose part of the mass during a change in the trajectory. The photon is emitted as a result of the mass defect of the orbital electron in the relativistic region of the speeds by the mechanism of synchrotron radiation.

The previously mentioned reasons for the behaviour of the orbital electron in the composition of the atom are investigated in greater detail in this book in analysis of photon radiation. Naturally, the fact that the previously mentioned problems of the orbital electron have not been solved greatly complicates the calculations of wave mechanics, restricted to statistical parameters of the electron. The development of the quantum theory on the basis of new fundamental discoveries and the previously mentioned assumptions enable us to transfer to the classic equations describing the state and behaviour of the orbital electron.

For example, the radial component of the speed of the orbital electron at the maximum distance from the atomic nucleus is equal to 0, and in the immediate vicinity of the atomic nucleus reaches the speed close to the speed of light. It is now clear that the probability of the electron being found at a specific radial distance from the nucleus correlates with the speed of the electron, describing a rosette-like trajectory and, consequently, determining the probability structure of the electron cloud. In particular, new approaches to the problem of the orbital electron make it not only possible to describe its trajectory but also determine the reasons for its probability parameters. Regardless of the deterministic nature of the new quantum mechanics, the methods of statistical physics with its probability parameters remain unshakable and in a number of cases they are controlling, as indicated by the example of capture by the photon of the atomic nucleus of the lattice of the optical medium in determination of the wave trajectory of the photon [3]. However, in contrast to the statistical nature of the wave function, the new probability parameters of the electron are characterised by the completely understandable physical nature.

The results will be of interest to experts in the area of the physics of elementary particles and the atomic nucleus and also quantum physics. However, most importantly, the results are of considerable applied significance in the development of quantum generators with high efficiency, for the development of quantum energetics and superconducting high-temperature materials, when the parameters of the optical medium determine the radiation or non-radiation of the orbital electron and conduction electrons and also determine the electrical conductivity (conduction) of the conductor (semiconductor), and in many other areas of science and technology.

The aim of this book with a limited volume is not to present analytically all possible spectrum of radiation of the atoms in the trajectories of the orbital electrons. This is a very large analytical study which should be preceded by the investigation of the current theory of the orbital electron, directed at determining the reasons for its unique behaviour in the composition of the atom, including at the moment of photon emission. The reasons for the behaviour of the orbital electron in the composition of the atom are studied in this book.

7.2. Concept of the discrete quantised electron

The orbital electron is capable of emitting a photon only because of its discrete structure in the quantised medium, being an open quasi-mechanical systems, like the atom as a whole. To understand the reasons for photon emission or non-emission by the orbital electron, it is necessary to mention the main assumptions of the theory of the electron, published in [4]. Previously, the following properties of the electron were known: charge $e = -1.6\cdot10^{-19}$ C, mass m_e=0.91·10^{-30} (0.511 MeV), magnetic momentum $\mu_e = 1.00116\ \mu_B$ (μ_B is the Bohr magneton), radius (classic) $r_e = 2.82\cdot10^{-15}\ m$, spin $\frac{1}{2}\hbar$, stable, lifetime $\tau > 2\cdot10^{22}$ years [13].

Prior to the development of the theory of EQM and TUEM (theory of the unified electromagnetic field), the electron was treated as an independent elementary particle being the carrier of the elementary electrical charge with negative polarity and mass. It was assumed that the electron is completely isolated from the quantised space-time, being an independent material substance, like 'matter in itself'. Regardless of the fact that this contradicted the principle of the corpuscular-wave dualism and the capacity of the particle mass to manifest itself in the form of the distorted space-time, the stereotype of this thinking was abandoned only as a result of discovering the superstrong electromagnetic interaction (SEI) [1].

In fact, the SEI returns to physics not only the light-bearing medium (electromagnetic aether) but on the whole determines the structure of the already quantised space-time in the form of the superstrong electromagnetic interaction (SEI) combining all the known interactions. It is now no longer rational to isolate the elementary particles from the quantised space-time and regard them as an integral unit with the quantised medium where the mass is reflected through the spherical deformation of the quantised medium. Consequently, the transfer of the mass of the particle in the space is determined by the wave transfer of spherical deformation of the quantised medium determining the wave and corpuscular properties of the particle [2].

The structure of the quantised medium, as a carrier of the superstrong interaction, and its parameters have been examined in detail in [1]. The structure of the quantised discrete electron as the compound part of the quantised medium was described in [4]. Therefore, it is rational to present only the main assumptions of the theory of Superintegration relating to the behaviour of the electron in the quantised medium which are essential for justifying the behaviour of the orbital electron in the composition of the atom.

It should be mentioned that until recently the physical vacuum was regarded as a substance with the minimum energy level manifested as a result of fluctuation of the zero energy level. This was a highly erroneous assumption based on the visual examination of the vacuum as an apparent emptiness since it was not not possible to penetrate directly into its quantised structure with the discreteness of the order of 10^{-25} m using direct instrument measurements.

The EQM theory changes the principal views regarding the physical vacuum and postulates that it has the maximum energy level and treats the physical vacuum as the only source of electromagnetic energy to which all other types of energy, including gravitational energy, are reduced in the final analysis. The energy is counted from the maximum level of the vacuum energy, although in re-normalisation this level may be regarded as a zero level and the observed changes of energy may be regarded as the fluctuation of the zero level when the equilibrium state of the quantised medium is disrupted. However, this is not so important, because the quantised medium in the equilibrium state can be visually perceived as an empty space. This visual perception is applied to all properties of the quantised space-time. The manifestation of electromagnetism and gravitation in the quantised medium is determined as the disruption of the electromagnetic and gravitational equilibrium of the medium [1, 2].

The main parameter, characterising the non-perturbed quantised medium, is the quantum density of the medium ρ_0, which determines the concentration of quantons in the unit volume of the space-time

$$\rho_0 = \frac{k_3}{L_{q0}^3} = 3.55 \cdot 10^{75} \frac{\text{particles}}{\text{m}^3} \tag{7.5}$$

where $L_{q0} = 0.74 \cdot 10^{-25}$ m is the quanton diameter; $k_3 = 1.44$ is the coefficient of filling of the volume by the spherical particles.

Gravitational perturbation of the quantised medium is accompanied by the redistribution of quantum density ρ which now already differs from ρ_0. Thus, for the electron whose mass formation is associated with the spherical deformation of the quantised medium, the distribution of the quantum density is described by the Poisson equation

$$\operatorname{div}(\mathbf{D}\gamma_n) = \operatorname{div}\operatorname{grad}(\rho\gamma_n) = 4\pi \frac{\rho_0}{C_0^2} G \rho_m \gamma_n \tag{7.6}$$

where $G = 6.67 \cdot 10^{-11}$ Nm^2/kg^2 is the gravitational constant; ρ_m is the density of the matter with the mass m, kg/m^3; $C_0^2 \approx 0.9 \cdot 10^{17}$ J/kg (m^2/s^2) is the gravitational potential of the non-perturbed vacuum; $\mathbf{D}$ is the vector of spherical deformation of the quantised medium, particles/m^4; γ_n is the normalised relativistic factor which has a specific value for the electron travelling with the speed v

$$\gamma_n = \frac{1}{\sqrt{1 - \left(1 - \frac{R_e^2}{r_e^2}\right) \frac{v^2}{C_0^2}}} \tag{7.7}$$

where $R_e = 6.74 \cdot 10^{-58}$ m is the electrical radius of the electron (the radius of the point charge); $r_e = 2.82 \cdot 10^{-15}$ *m* is the classic radius of the electron.

The normalised relativistic factor γ_n restricts the mass and energy of the particle when the latter reaches the speed of light by the limiting parameters $m_{\max}$ and $W_{e\max}$ [4]

$$m_{e\max} = \frac{C_0^2}{G} r_e = 3.8 \cdot 10^{12} \text{kg} = 4.2 \cdot 10^{42} m_e \tag{7.8}$$

$$W_{e\max} = m_{e\max} C_0^2 = \frac{C_0^4}{G} r_e = 3.4 \cdot 10^{29} \text{J} = 4.2 \cdot 10^{42} W_0 \tag{7.9}$$

It can be seen that the limiting parameters of the electron are $4.2 \cdot 10^{42}$ times greater than the mass m_e and rest energy W_0 of the electron.

The classic radius of the electron r_e determines the calculation parameters of the gravitational boundary of the electron in the condition when its electrical energy W_e is equal to the gravitational energy W_0 of the rest state $m_0 C_0^2$, determining the depth r'_e of the gravitational boundary [4]

$$W_e = W_0, \quad \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r_e} = m_e C_0^2 \tag{7.10}$$

$$r'_e = r_e \pm R_e \tag{7.11}$$

The electrical radius R_e of the point charge of the electron indicates the equivalence of its maximum electrical energy $W_{e\max}$ and the limiting gravitational energy $W_{\max}$ (7.9) with the deformation energy of the quantised medium

$$W_{e\max} = W_{\max}, \quad \frac{1}{4\pi\varepsilon_0} \frac{e^2}{R_e} = \frac{C_0^4}{G} r_e \tag{7.12}$$

From (7.12) and (7.10) we obtain that the electrical radius R_e is equal to the gravitational radius R_g of the electron [4]

$$R_e = R_g = \frac{G m_e}{C_0^2} = 6.74 \cdot 10^{-58} \text{m} \tag{7.13}$$

The gravitational radius of the electron R_g is only the calculation auxiliary parameter with no actual meaning, because the electron is a non-collapsing object. The electrical radius R_e of the point electrical charge of the electron is important for the electron.

If a massless point elementary electrical charge ($-e$ or e^-) is placed in the quantised medium, the quantons under the effect of electrical forces and also, as shown in [4], magnetic forces, start to move to the central charge ($-e$) spherically deforming the medium. Two characteristic regions should be specified here: the region of compression and the region of tension separated by the gravitational boundary r_e' (7.11). Mathematically, the deformed state of the quantised medium is described by the Poisson equation (7.6). The solution of this equation is represented by the distribution of the quantum density of the medium for the region of tension ρ_1 and the region of compression ρ_2 [4]

$$\begin{cases} \rho_1 = \rho_0\left(1 - \dfrac{R_e}{r}\gamma_n\right), & r \geq r_e \\ \rho_2 = \rho_0\left(1 + \dfrac{R_e}{r}\gamma_n\right), & r_e \geq r \geq R_e \end{cases} \tag{7.14}$$

Solution of (7.14) confirms the effect of the principle of spherical invariance for the initial electron when regardless of its uniform and straight line speed v, which is included in γ_n (7.7), the distribution of quantum density ρ_1 and ρ_2 remains spherical in relation to the point charge ($-e$) of the electron. The nonuniformity of the quantum density (7.14) is characterised by the deformation vector **D** of the medium which is included in (7.6) as a quantum density gradient

$$\mathbf{D} = \operatorname{grad}\rho \tag{7.15}$$

$$\begin{cases} \mathbf{D}_1 = \rho_0 \dfrac{R_e}{r^2}\gamma_n \cdot \mathbf{1}_r, & r \geq r_e \\ \mathbf{D}_2 = -\rho_0 \dfrac{R_e}{r^2}\gamma_n \cdot \mathbf{1}_r, & r_e \geq r \geq R_e \end{cases} \tag{7.16}$$

Here $\mathbf{1}_r$ is the unit vector directed away from the central point charge ($-e$) of the electron along the radius r.

The region of tension for ρ_1 determines the direction of the deformation vector $\mathbf{D}_1$ in (16) from the central charge of the electron, and the region of compression for ρ_2 determines the direction of the deformation vector $\mathbf{D}_2$ towards the central charge ($-e$). On the sphere with radius r_e which characterises the gravitational boundary (7.11) of the electron in the quantised medium, the deformation vectors $\mathbf{D}_1$ and $\mathbf{D}_2$ are applied to the boundary from different sides in the opposite direction.

It is characteristic that the flow $\mathbf{\Phi}_1$ of the deformation vector $\mathbf{D}_1$ (7.16) on the closed surface $4\pi r^2$ around the region of tension ρ_1 is proportional to the mass of the particle taking into account (7.30) and to proportionality coefficient k_m and is directed to the external region of space:

$$\mathbf{\Phi}_1 = \int_S \mathbf{D}_1 dS = 4\pi\rho_0 R_e \gamma_n \cdot \mathbf{1}_r = 4\pi \frac{\rho_0}{C_0^2} G m_e \gamma_n \cdot \mathbf{1}_r = k_m m \cdot \mathbf{1}_r \tag{7.17}$$

$$m = m_e \gamma_n \tag{7.18}$$

If the deformation $\mathbf{D}_1$ of the medium is removed from (7.17), the mass m disappears. The equation (7.17) again shows convincingly that the mass of the particle is a secondary formation as a result of the spherical deformation of the quantised medium.

Prior to the development of the theory of EQM and Superintegration, physics did not examine the internal region of the particle. When it was possible to look inside the electron, it was found that it contains minus mass, hidden from examination and characterised by deformation vector $\mathbf{D}_2$. At the distances smaller than the classic radius of the electron, the minus mass start to be evident in the form of the force of anti-gravitational repulsion determining the negative value of the vector of the strength (–**a**) of the gravitational field [2]

$$\begin{cases} \mathbf{D}_1 = \rho_0 \dfrac{R_e}{r^2} \gamma_n \cdot \mathbf{1}_r = \dfrac{\rho_0}{C_0^2} \dfrac{G m_e}{r^2} \gamma_n \cdot \mathbf{1}_r = \dfrac{\rho_0}{C_0^2} \mathbf{a} \gamma_n, \quad r \geq r_e \\ \mathbf{D}_2 = -\rho_0 \dfrac{R_e}{r^2} \gamma_n \cdot \mathbf{1}_r = \dfrac{\rho_0}{C_0^2} \dfrac{G(-m_e)}{r^2} \gamma_n \cdot \mathbf{1}_r = \dfrac{\rho_0}{C_0^2} (-\mathbf{a}) \gamma_n, \quad r_e \geq r \geq R_e \end{cases} \tag{7.19}$$

Equation (7.19) confirms that the deformation vector $\mathbf{D}_1$ ($-\mathbf{D}_2$) (7.16) is an analogue of the vector of the strength **a** of the gravitational field of the electron which determines the freefall acceleration **a** in the external region and the acceleration of free repulsion (–**a**) in the internal region.

The anti-gravitational repulsion effect is even stronger at the gravitational boundary r_e' (7.11) of the electron which divides the regions of compression and tension of the quantised medium. To determine the maximum value of the deformation vector $\mathbf{D}_{max}$, a 'jump' $\Delta\rho$ of the quantum density of the medium (7.14) is defined on the surface of the gravitational boundary of the electron

$$\Delta\rho = \rho_1 - \rho_2 = -\rho_0 \frac{2R_e}{r_e} \gamma_n \tag{7.20}$$

The width of the gravitational boundary from (7.11) equals $\Delta r = 2R_e$ so that we can determine the vector $\mathbf{D}_{max}$ taking (7.10) into account

$$\mathbf{D}_{max} = \frac{\Delta\rho}{\Delta r} \mathbf{1}_r = -\frac{\rho_0 \gamma_n}{r_e} \mathbf{1}_r = -\frac{4\pi\varepsilon_0 m_e C_0^2}{e^2} \rho_0 \gamma_n \mathbf{1}_r \tag{7.21}$$

The maximum value of the strength of the gravitational field ($-\mathbf{a}_{max}$) of the electron at the gravitational boundary is determined on the basis of the equivalence of the strength with the deformation vector (7.21)

$$\mathbf{a}_{max} = \frac{C_0^2}{\rho_0}\mathbf{D}_{max} = -\frac{C_0^2}{r_e}\gamma_n \mathbf{1}_r = -3.2\cdot 10^{31}\gamma_n \mathbf{1}_r \left[\mathrm{m/s^2}\right] \quad (7.22)$$

It can be seen that the gravitational boundary of the electron is the zone of gravitational repulsion (7.22) which predetermines its capture by the atom nucleus, with the exception of capture of the proton by the electron.

The quantum density of the medium (7.14) and the vector of deformation of the medium (7.16) are new parameters of the electron which are noticeable and non-formal. However, these parameters are not used widely in physics. As shown in (7.19) and (7.22), the new parameters of the quantised medium are connected with the well-known vector of strength **a** of the gravitational field and, consequently, the gravitational potential φ which is an analogue of the quantum density of the medium ρ[2]

$$\varphi = \frac{C_0^2}{\rho_0}\rho, \quad \rho = \frac{\rho_0}{C_0^2}\varphi \quad (7.23)$$

Substituting (7.23) into (7.6) we obtain the well-known Poisson gravitational equation for the gravitational potential φ

$$\operatorname{div}(\mathbf{a}\gamma_n) = \operatorname{div}\operatorname{grad}(\varphi\gamma_n) = 4\pi G\rho_m\gamma_n \quad (7.24)$$

Therefore, the complete solution of the Poisson gravitational equation (24) can be found only in the Superintegration theory, analysing the distribution of the quantum density of the medium (7.14) for the electron in the region of tension and compression of the medium and determining the analogue distribution of the gravitational potentials $\varphi_1 = C^2$ and φ_2 for the regions of tension and compression of the medium, respectively [2]

$$\begin{cases} \varphi_1 = C^2 = \dfrac{C_0^2}{\rho_0}\rho_1 = C_0^2\left(1-\dfrac{R_e}{r}\gamma_n\right), & r \ge r_e \\ \varphi_2 = \dfrac{C_0^2}{\rho_0}\rho_2 = C_0^2\left(1+\dfrac{R_e}{r}\gamma_n\right), & r_e \ge r \ge R_e \end{cases} \quad (7.25)$$

Figure 7.1 shows the gravitational diagram of the electron in the form of distribution of the gravitational potentials (7.25) for the internal region (zone) of compression (*c–d–e*) and the external region of tension (*a–b–c*). The detailed description of the gravitational diagram of the electron is found in [2].

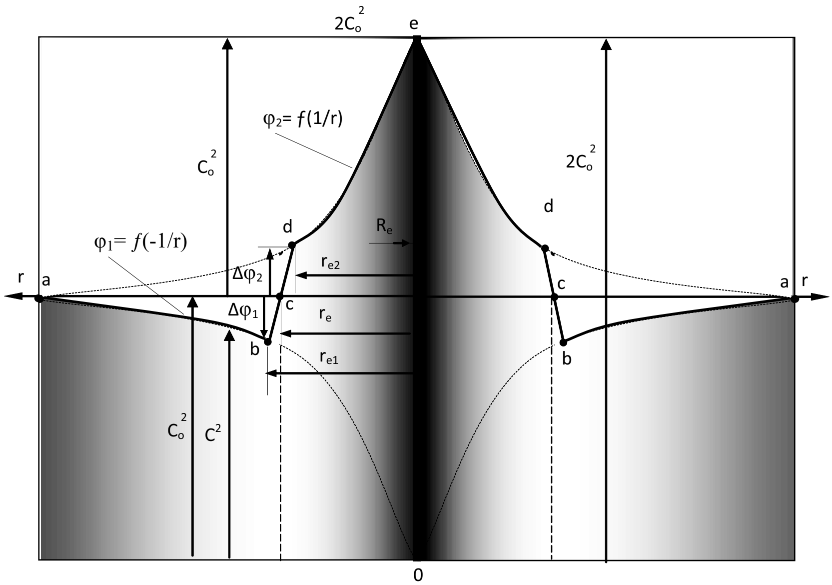

Fig. 7.1. Gravitational diagram of the electron in the form of distribution of the gravitational potential in the zone of compression (*d–e*) and the region of tension (*a–b*) of the spherically deformed quantised space-time.

Attention should be given to the fact that the equilibrium state of the quantised medium is represented by the line of the gravitational potential C_0^2 (or quantum density ρ_0), with deformation changes in the medium during the formation of the electron mass taking place in relation to this potential. The depth of the quantised medium is determined by the difference of the gravitational potentials $0–C_0^2$ (or $0–\rho_0$). The gravitational potential has the maximum value $2C_0^2$ (or $2\rho_0$) on the surface of the electrical radius R_e (7.13) of the electron.

Only on the basis of the quantum density of the medium ρ_0 can it be concluded that vacuum is characterised by the gravitational potential C_0^2 and not $\varphi = 0$, as was erroneously assumed before the EQM theory was developed. This is confirmed by the equivalence of the energy W_0 and the rest mass m_e of the electron

$$W_0 = \int_0^{C_0^2} m_e d\varphi = m_e C_0^2 \tag{7.26}$$

Integral (7.26) determines the work associated with the transfer of mass m_e as a gravitational charge from the virtual infinity with the zero gravitational potential to the region of the quantised medium with the gravitational potential C_0^2 when a particle with mass m_0 is formed. Equation (7.26) is the simplest and easiest to understand conclusion of the equivalence of mass and energy. Using a reversed procedure, we obtain from (7.26) that the quantised medium has the potential C_0^2.

The formation of the electron mass is determined by the spherical deformation of the quantised medium (7.17). The gravitational boundary between the zones of compression and tension is represented by the line (b–c–d) which is characterised by the anti-gravitational repulsion effect (7.22), like the entire zone of compression with the negative deformation vector ($-\mathbf{D}_2$) (7.19). It is characteristic that the energy zone of compression hides in itself the colossal energy W_{emax} (7.14) associated with the point dimensions of the electrical radius R_e (7.13) of the electron.

The zone of tension (*a–b–c*) is characterised by a gravitation well whose deformation energy is determined by the integral (7.26) and corresponds to half the rest mass. As reported in [4], the second half of the deformation energy is introduced in a small amount into the minus mass of the electron (part of the gravitational hillock), balancing the tension of the gravitational well and determining the stability of the electron in the quantised medium. The gravitational well includes the zone of gravitational attraction characterised by the distribution function of the gravitational potential $\varphi_1 = C^2$ (7.24) which determines the external gravitational field of the electron. The gravitational potential C^2 is the potential of action because it actually characterises the distribution of the gravitational potential and the quantum density of the medium for the electron.

With the increase of the speed of the electron, the integral (7.26) is multiplied by the normalised relativistic factor γ_n (7.7), determining the spherical invariance of the gravitational diagram irrespective of the speed of movement. Consequently, the movement of the electron in the quantised medium should be treated as the movement of its point electrical charge ($-e$) with radius R_e (7.30) characterising the transfer in the space of the gravitational diagram of the spherical deformation of the medium. This determines the wave transfer of mass and explains the fundamental nature of the principle of corpuscular-wave dualism of the particle.

In fact, in the ‘matter in itself’ concept, the electron has no mass. The electron mass is quantised in its nature and represents a bunch of the spherically deformed quantised medium capturing during wave motion into its composition a very large number of quantons, forming the quantised structure of the electron. Consequently, the electron mass can get fragmented and manifest itself in the form of a mass defect and is the equivalent of the elastic energy of spherical deformation of the quantised medium which, after release, determines the radiation energy of the photon.

Understanding this and knowing the quantised structure of the electron, we can analyse the condition of its radiation or non-radiation.

The partial (or complete) mass loss by the electron in the form of the mass defect is associated with the release of the elastic energy of deformation of the quantised medium. Since the quantised medium has the form of a static electromagnetic field, being the carrier of superstrong interaction (SEI), the release of part of the energy of the elastic deformation of the medium by the electron generates a wave electromagnetic process in the medium and this process is observed as photon emission.

The description of the electron structure is incomplete without describing its spherical magnetic field together with the radial electrical field of the point charge and connection with the gravitational diagram. Previously, the spherical fields, i.e., the fields closed on the sphere and completely balanced, were not investigated in the theory of electromagnetism. However, the spherical magnetic field in particular has made it possible to explain the presence of magnetic 'spin' in the electron which is not explained by the rotation of the electron, including rotation around the natural axis, and is associated with the specific features of the behaviour of the quantised medium around the point charge of the electron [4].

Figure 7.2 shows the scheme of formation of the spherical magnetic field in the vicinity of the central point charge of the electron (a) and in movement away from it (b). In projection, the quanton has the form of an electromagnetic quadrupole including two dipoles: electrical and magnetic, and the axes of the dipoles are orthogonal to each other. In the immediate vicinity of the point charge of the electron the quantons try to orient the

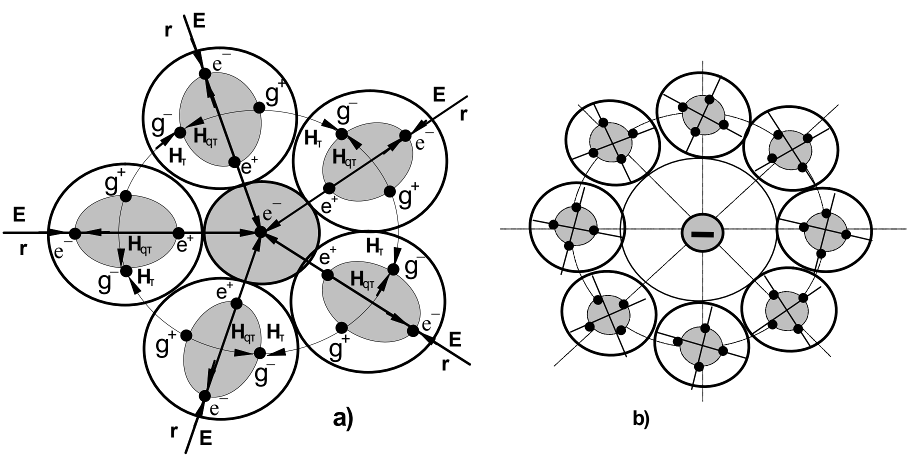

Fig. 7.2. Diagram of formation of the spherical magnetic field in the vicinity of the point charge of the electron (a) and away from it (b).

axes of the electrical dipoles of the force lines of the radial electrical field of the spherical charge of the electron. In this case, the axes of the magnetic dipoles close on the sphere, forming the spherical magnetic field of the electron. In particular, this electron field provides the maximum contribution to the deformation of the quantised medium in formation of the electron mass [4].

For the simultaneous description of the radial electrical and spherical magnetic field of the electron, it is convenient to introduce the concept of the complex electron charge q expressing it in the electrical units of measurement of the charge, taking into account the relationship between the elementary magnetic g and electrical e charges $g = C_0 e$, where i is the imaginary quantity

$$q = e + \frac{1}{C_0} ig \tag{7.27}$$

The complex charge of the electron q (7.27) can be expressed in the magnetic units of measurement of the charge or in electrical and magnetic units $q = e + ig$.

Consequently, the complex static electromagnetic potential φ_q of the electron can be represented by the distribution function of the actual electrical φ_e and the imaginary magnetic φ_g potentials of the point complex charge q (7.27)

$$\varphi_q = \frac{q}{4\pi\varepsilon_0 r} = \frac{1}{4\pi\varepsilon_0 r}\left(e + \frac{ig}{C_0}\right) = \frac{e}{4\pi\varepsilon_0 r} + \frac{1}{\varepsilon_0 C_0}\frac{ig}{4\pi r} = \varphi_e + \frac{1}{C_0} i\varphi_g \tag{7.28}$$

The complex strength $\mathbf{Q}$ of the static electromagnetic field of the electron is determined as the gradient of the function of the complex potential φ_q (7.28)

$$\mathbf{Q} = \text{grad}(-\varphi_q) == \frac{e}{4\pi\varepsilon_0 r^2}\mathbf{1}_r + \frac{1}{\varepsilon_0 C_0}\frac{g}{4\pi r^2} i\mathbf{1}_r = \mathbf{E} + \frac{i\mathbf{H}}{\varepsilon_0 C_0} \tag{7.29}$$

The vectors of the strength of the radial electrical $\mathbf{E}$ and spherical magnetic $i\mathbf{H}$ fields of the electron are orthogonal and their moduli are connected by the relation:

$$H = (\varepsilon_0 C_0) E = \frac{g}{4\pi r^2} \tag{7.30}$$

The strength of the spherical magnetic field $i\mathbf{H}$ is determined by the components $\mathbf{H}_\tau$ and $\mathbf{H}_{q\tau}$ (Fig. 7.2a) which show that their moduli (modulus $i\mathbf{H}$ is denoted by H_i) are equal for the equilibrium state of the magnetic field when moving away from the central charge of the electron (Fig. 7.27b)

$$H_i = H_\tau = H_{q\tau} \tag{7.31}$$

It was shown in [4] that the spherical magnetic field of the electron, because of its closed form, has a considerably stronger force effect on the quantised medium than the effect of the radial magnetic field.

The presence in the electron of the spherical magnetic field makes it possible to determine the parameter of the spin of the electron S_e which for the orbital electron is measured in the units of $\hbar$ (where $\hbar = 1.05 \cdot 10^{-34}\, J \cdot s$ is the Planck constant)

$$S_e = \frac{1}{2}\hbar \tag{7.32}$$

It should be mentioned that the Planck constant $\hbar$ is equivalent to the momentum of the amount of motion of the orbital electron on the first Bohr orbit with radius r_0

$$\hbar = m_e v \cdot r_0 \tag{7.33}$$

The Bohr magneton μ_B determines the magnetic momentum of the orbital electron in the composition of the atom as a contour with current in the SI taking $\hbar$ (7.33) into account

$$\mu_B = \frac{1}{2} e v \cdot r_0 = \frac{1}{2}\hbar \frac{e}{m_e} = 9.27 \cdot 10^{-24} \frac{\text{J}}{\text{T}} = \text{A} \cdot \text{m}^2 = \text{Dc} \cdot \text{m} \tag{7.34}$$

The magnetic momentum of the orbital electron μ_B (7.34) is measured in the units of magnetic charge [Dc · m]. Therefore, the electrical charge e in the magnetic momentum of the electron μ_B should be replaced by the equivalent modulus g of the imaginary magnetic charge ig/C_0 of the electron from (7.27)

$$\mu_B = \frac{1}{2}\hbar \frac{g}{m_e C_0} \qquad [\text{A} \cdot \text{m}^2 = \text{Dc} \cdot \text{m}] \tag{7.35}$$

Equation (7.35) determines the magnetic momentum of the orbital electron reaches expressed by the elementary magnetic charge g.

Equation (7.35) includes the Compton wavelength λ_0 of the electron

$$\lambda_0 = \frac{\hbar}{m_e C_0} = 3.86 \cdot 10^{-13} \text{m} \tag{7.36}$$

Taking equation (7.36) into account, we obtain the value of the magnetic momentum μ_B (7.35) of the orbital electron in the composition of the atom and express it through the elementary magnetic charge g and the Compton wavelength λ_0

$$\mu_B = \frac{\lambda_0}{2} g = 9.27 \cdot 10^{-24} \mathrm{Dc} \cdot \mathrm{m} \qquad (7.37)$$

Equation (7.37) shows that the equivalent of the Bohr magneton μ_B is the magnetic dipole consisting of two elementary magnetic charges $\pm g$, situated at the distance equal to half the Compton wavelength $\lambda_0/2$. The magnetic axis of the dipole, connecting the magnetic charges $\pm g$, is orthogonal to the plane of the electron orbit for a single turn. The magnetic momentum μ_B (7.37) is connected with the first Bohr orbit which can be regarded as the average parameter of the complex stationary orbit in the simplest case of the hydrogen atom. The rotation of the orbital electron results in the magnetic polarisation of the atom which is determined by the equation (7.37).

Naturally, the above considerations, relating to the magnetic momentum of the orbital electron in the composition of the atom, cannot be transferred directly to the free electron which, in contrast to the atom, does not have distinctive magnetic polarisation. The magnetic spherical field of the free electron is polarised only topologically on the sphere, without disrupting the magnetic equilibrium of the medium. On the other hand, the magnetic dipoles of the quantons, oriented on the sphere in the composition of the electron, carry out topological orientational magnetic polarisation of the quantised medium around the electrical charge of the electron (Fig. 7.27). Evidently, it may be attempted to take into account the given magnetic polarisation of the free electron by introducing the imaginary magnetic moment.

Formally, equation (7.37) shows that the Compton wavelength λ_0 and the imaginary magnetic charge of the electron ig determine its magnetic momentum which is the imaginary parameter for the free electron

$$\mu_B = \frac{\lambda_0}{2} ig = \sqrt{-1} \cdot 9.27 \cdot 10^{-24} \mathrm{Dc} \cdot \mathrm{m} \qquad (7.38)$$

In the case of the orbital electron, its imaginary magnetic momentum (7.30) is transferred to the actual parameter (7.37).

It is interesting to consider the purely hypothetically minimum magnetic momentum of the electron $\mu_{e\min}$, determined by the interaction of the magnetic charge with the identical charge at the distance of the classic electron radius r_e

$$\mu_{e\min} = ig \cdot r_e = \sqrt{-1} \cdot 1.35 \cdot 10^{-25} \mathrm{Dc} \cdot \mathrm{m} \qquad (7.39)$$

Dividing (7.39) by (7.38) we obtain the required value of the fine structure α

$$\frac{\mu_{e\min}}{\mu_Б} = 2\frac{r_e}{\lambda_0} = 2\frac{1}{137} = 2\alpha \qquad (7.40)$$

$$\alpha = \frac{r_e}{\lambda_0} = \frac{1}{137} \tag{7.41}$$

As indicated by (7.40), α is determined by the ratio r_e/λ_0. This is understandable since the classic radius of the electron r_e determines its rest energy $m_e C_0^2$. On the other hand, the Compton wavelength λ_0 is connected with the photon energy which is equivalent to the rest energy of the electron $m_e C_0^2$

$$\hbar \frac{C_0}{\lambda_0} = m_e C_0^2 \tag{7.42}$$

In fact, the constant of the fine structure α (7.41) determines the relationship between the corpuscular (r_e) and wave (λ_0) parameters of the electron on the basis of the electromagnetic nature of the electron in the quantised medium.

Figure 7.3 shows the structure of the electron in the quantised space-time as a result of its spherical deformation by the radial electrical field of the central charge. The structure of the quantised electron was obtained as a result of computer simulation of the deformation of the medium (for better understanding, the scale is not given). The centre of the electron contains a point electrical charge. The dark region shows the zone of compression of the quantised medium around the charge, the light region is the zone of tension which gradually merges with the non-perturbed quantised medium. Although the quanton electron is characterised by a rotor with narrow gravitational boundary between the zones of compression and tension, it appears to be 'spread' of the space, being its compound and inseparable part [4].

Thus, the brief analysis of the electron structure shows that the electron,

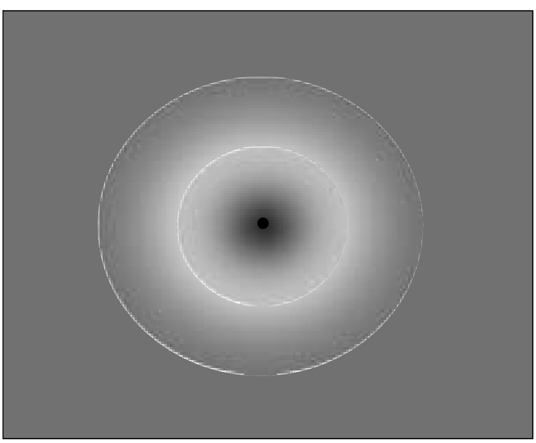

Fig. 7.3. Computer simulation of the structure of the electron in the quantised space-time as a result of its spherical deformation by the radial electrical field of the central charge.

being the integral part of the quantised space-time, has a discrete quantised structure. The discrete mass of the electron in the form of the spherically deformed region of the quantised medium around the central electrical charge (e^-) of the electron should be capable of changing through the mass defect. As already mentioned, the Maxwell electrodynamics does not work inside the atom, i.e., the variation of the strength of the electrical field between the orbital electron and the atom nucleus does not cause any electromagnetic radiation. Therefore, the photon radiation of the orbital electron can be explained on the basis of its electrondynamics in the composition of the atom, and the mass defect must be considered as the reason. This is justified taking into account the discrete structure of the quantised electron and, more accurately, its mass, which is capable of disintegration through the mass defect. Taking into account that the mass (mass defect) is the equivalent of the elastic energy of the spherically deformed quantised medium which is based on the superstrong electromagnetic interaction (SEI), the transformation of this energy into electromagnetic photon radiation is the only possible reason for the photon radiation of the orbital electron. In particular, this aspect of the nature of the radiation of the orbital electron through its mass defect has not been explained theoretically in quantum mechanics.

7.3. Special features of the structure of the proton, neutron and the atomic nucleus

The orbital electron rotates in the composition of the atom inside the gravitational well of the atomic nucleus whose effect was not previously taken into account in quantum theory. In particular, the rotation of the orbital electron inside the gravitational well of the nucleus determines its unique properties. However, prior to analysing of the behaviour of the orbital electron inside the gravitational well of the nucleus, we examine the structure of the atomic nucleus from the viewpoint of the concept of Superintegration of fundamental interactions in which the nuclear forces are manifested through the superstrong electromagnetic interaction as the forces of electrostatic attraction of the alternating shells of the nucleons (the proton and the neutron) [5].

The internal structure of the proton, the neutron and, correspondingly, the atomic nucleus was not known prior to the development of the Superintegration theory with the exception of the fact that the nucleus consists of nucleons (protons and neutrons) and the mentioned elementary particles have a complicated structure and in fact are not elementary. At the same time, a certain amount of experience has been accumulated in the investigations of nucleons and the atomic nucleus whose properties are described below.

The proton: mass $m_p = 1.67 \cdot 10^{-27}$ kg = 938.3 MeV ≈1836 m_e, the charge $+e = 1.6 \cdot 10^{-19}$ C, the magnetic momentum μ_p=2.79 μ_n (μ_n is the nuclear magneton), spin ½$\hbar$, the mean quadratic radius $0.8 \cdot 10^{-15}$ m, stable, lifetime $\tau > 1.6 \cdot 10^{25}$ years [14].

The neutron: mass $m_n = 1.675 \cdot 10^{-27}$ kg = 939.6 MeV ≈ 1840 m_e, $m_n - m_p$ = 1.3 MeV, charge – electrically neutral with the accuracy to 10^{-22} e, magnetic moment $\mu_p = -1.91\ \mu_n$ (μ_n is the nuclear magneton), μ_p/μ_p–3/2, spin ½$\hbar$, the mean quadratic radius $0.8 \cdot 10^{-15}$ m, unstable in the free state, lifetime $\tau \approx 15.3$ min [15].

To understand the reasons for the behaviour of the orbital electron in the composition of the atom, it is necessary to know and understand the structure of the nucleons and the atomic nucleus and the nature of nuclear forces. In this respect, the Superintegration theory does not ignore the generally accepted positions in which the composition of the atomic nucleus is regarded as a complicated structure including two types of particles: protons and neutrons, connected together by nuclear forces. The difference is that the nature of the nuclear forces in the Superintegration theory is electrical [5]. Previously, it was assumed that up to the development of quantum chromodynamics (QCD) the nature of the nuclear forces cannot in principle be electrical because one of the nucleons (neutron) is an electrically neutral particle but is capable of interaction with other nucleons in the composition of the atomic nucleus. It was also assumed that this interaction results in the formation of special nuclear forces representing an independent fundamental interaction referred to as the strong interaction.

The concept of the independence and peculiarity of the nuclear forces contradicts the concept of Superintegration of interactions according to which all the known forces (interactions) should in the final analysis be reduced to the single force represented by the superstrong electromagnetic interaction. This is the distinguishing feature of the uniqueness of nature in the Superintegration theory which determines the electromagnetic nature of our universe. Discussion has been going on for several decades regarding the strong interaction and it was erroneously assumed that there is no stronger interaction in the nature than the nuclear interaction. The logics of these discussions should be reduced to the integration of the known interactions through the strong interaction which should control all other forces.

However, nobody has yet succeeded in proposing a Superintegration theory which would be based on nuclear forces. Consequently, we unintentionally arrive at the concept of the fifth force which could integrate the strong interaction with all other interactions (gravitation, electromagnetism, electroweak interactions). This fifth force can be represented only by the Superforce in the form of the superstrong electromagnetic interaction. Only the Superforce can control all other forces. This is the golden rule of mechanics. As we penetrate deeper into the matter (inside the quantised medium) we encounter higher and higher energy concentrations. The effect of nuclear forces is evident at distances of the order of 10^{-15} m, and the effect of the Superforce of the SEI at 10^{-25} m.

One of the fundamental manifestations of the Superforce is the formation of the mass of elementary particles. It should be mentioned that the discrete structure of the elementary particles, including the nucleons, is the compound part of the quantised medium. The only common feature of all the elementary particles having mass, and these particles include the orbital electron and the nucleons, is the capacity of the particles to carry out spherical deformation of the quantised medium resulting in the formation of the mass of the particles [2, 4].

However, from the technical viewpoint, the process of formation of the mass of the electron and the nucleon takes place by different mechanisms. Whilst in the electron of the electrical charge of the electron pulls the quantons to its centre, carrying out spherical deformation of the quantised medium [4], then in, for example, the neutron which is an electrically neutral particle, the mechanism of spherical deformation of the medium is associated with the structure of its alternating shell, and the paired ratio of the monopole charges of the shell determines the electroneutrality of the neutron with increasing distance from it. On the other hand, the proton, having a non-compensated electrical charge with positive polarity in the composition of the shell, has the same mechanism of formation of its mass as the neutron and the spherical deformation of the quantised medium is carried out by the alternating shell of the nucleon. In particular, the interaction of the alternating shells of the nucleons determines the electrical nature of the nuclear forces at distances of the order of 10^{-15} m [5].

Attention should be given to the fact that the new concept of the nuclear interactions provides a strong impetus to the development of the quantum chromodynamics (QCD). In QCD, the nuclear forces are determined by the quark structure of the nucleons, assuming that the quarks are tiny electrical charges included in the structure of the nucleons and they determine the electrical nature of the nuclear forces. Regardless of the attempts to attribute to the quarks the properties of whole electrical charges, the QCD does not solve the problem of formation of the mass of the nucleons and of the atomic nucleus in the quantised medium. All the contradictions of the QCD, formed during its development, have been removed by transferring the main aspect of quantisation of the nucleons by the quarks to the quantised medium. Four whole charges play the role of new quarks: two electrical (+1*e* and –1*e*) and two magnetic (+1*g* and –1*g*), which are included in the composition of the quanton (the space-time quantum). Consequently, the formation of elementary particles in the quantised medium requires only whole electrical charges (+1*e* and –1*e*). For the electron and the positron, the whole electrical charge is a central charge, and spherical deformation of the quantised medium, forming the particle mass, takes place around the central charge [4]. In the case of the nucleons, the whole electrical charges are included in the composition of the alternating shell which also carries out the spherical deformation of the quantised medium, forming the nucleon mass [5]. QCD does not possess such universal and non-contradicting assumptions.

The shell model of the nucleons is confirmed by experiments which showed that the nucleons are particles of complicated composition and they include a large number of the centres of electrical nature which are determined by the alternating shell of the nucleons. In the past, this resulted in the quark concept of the structure of nucleons and in the development of the QCD. This book does not discuss all the current problems of the QCD which, in fact, have already been solved in the Superintegration theory, and is aimed at returning the concept of integrated quarks forming the structure of the nucleons, taking into account the fact that it is necessary to search for whole electrical charges. The presence in natgure of the whole charges has been confirmed by experiments and they are not doubted, in contrast to the proof of the presence in nature of the tiny electrical charges.

Most importantly, the whole electrical charges are harmonically included in the shell model of the nucleons. For this purpose, the whole charges of the negative and positive polarity must be distributed on the sphere in the form of an alternating network with the alternation of the polarity of the charges in the nodes. The structure of the nucleons has been examined in considerable detail in [5] and it is not therefore necessary to repeat it and it is sufficient to mention the main assumptions relating to the photon, especially to the nature of radiation or non-radiation of the orbital electron in the composition of the simplest hydrogen atom whose nucleus consists of a proton. It must be mentioned that in [5] no mention is yet made of the forces of anti-gravitational repulsion between the elementary electrical charges which were investigated in [4] and their inclusion in [5] completes the description of the nature of the nuclear forces as the forces of electrical interaction at the distances of the order of 10^{-15} m between the alternating shells of the nucleons.

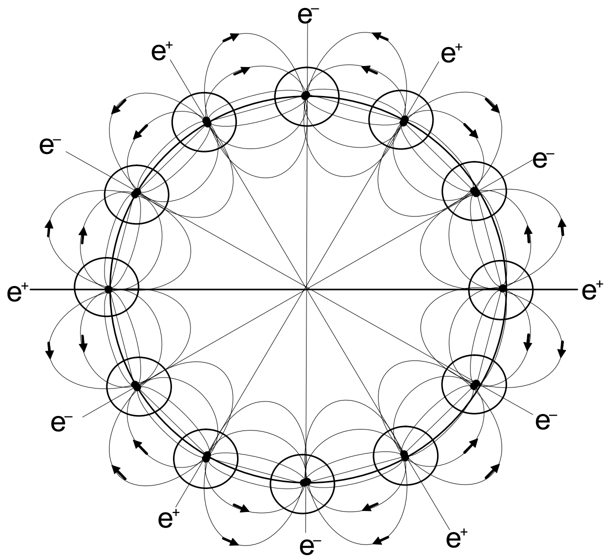

Fig. 7.4. Distribution of the electrical charges in the cross-section of the alternating shell of the nucleon and the alternating electrical field of the shell.

Figure 7.4 shows the distribution of the electrical charges ($+e$ and $-e$) in the cross-section of the alternating shell of the nucleon and the alternating electrical field of the shell. The charges at the nodes of the alternating network are indicated by points. In the neutron, the alternating network is completely electrically neutral because it includes the paired number of the charges of different polarity, compensating the charge signs. In the proton, the composition of the alternating shell includes the uncompensated electrical charge of positive polarity. This shell model of the nucleon satisfies its properties:

– the alternating shell of the nucleon determines the complicated internal structure of the nucleon with a large number of electrical centres, regardless of the presence of the uncompensated charge of positive polarity at the proton and the electrical neutrality of the neutron;

– the alternating shells of the nucleons inside the atomic nucleus can interact with each other by short-range forces of electrical attraction and repulsion which are perceived as nuclear forces;

– the alternating shell of the nucleon has the role of the gravitational boundary of the particle, ensuring the strong spherical compression of the quantised medium in the formation of the nucleon mass which is almost 2000 times greater than the electron mass;

– the nucleon shell in the form of the alternating network freely penetrates through the quantised medium resulting in the wave transfer of the nucleon mass and, correspondingly, the mass of the atomic nucleus, satisfying the principle of corpuscular-wave dualism [5].

On the other hand, the presence of the alternating shell of the nucleon explains the behaviour of the orbital electron inside the atomic nucleus. This will be investigated on the example of approach of the electron to a proton nucleus when the radial electrical field of the proton changes to the alternating electrical field of the shell of the proton which has a tangential component (Fig. 7.4). It has already been mentioned that the forces of anti-gravitational repulsion operate in the vicinity of the proton nucleus between the orbital electron and the proton and they prevent the electron from falling on the nucleus. Now, it should be added that the orbital electron in the vicinity of the atomic nucleus penetrates into the field of the effect of tangential forces which may both push the electron forward or inhibit its movement, or act alternately by deceleration and acceleration. Although not very likely, the electron can also be captured by the proton because of the complicated configuration of the alternating electrical field of the proton as a result of tunnelling of the electron into the proton shell [5].

The complicated behaviour of the electron in the vicinity of the atomic nucleus indicates that the radiation of the orbital electron takes place in the immediate vicinity of the atomic nucleus, in the field of the strongest acceleration to which the electron is subjected. This is also determined by the condition of formation of the photon in the range of relativistic speeds [3]. In other cases, the electron cannot radiate at any coordinate point of its orbit. However, prior to investigating the conditions of non-radiation of the orbital electron, it must be mentioned that the electron in the atom is situated inside the gravitational well of the nucleus. The effect of the gravitational well of the behaviour of the orbital electron was not previously taken into account.

Figure 7.5 shows the gravitational diagram of the proton (or the atomic nucleus) which differs from the gravitational diagram of the electron (Fig. 7.1). The diagram is presented in a slightly simplified form, assuming that the gravitational boundary of the proton is continuous and not discrete as in Fig. 7.4. This assumption is not important for the evaluation of the behaviour of the orbital electron in the composition of the atom. It is important to note that outside the limits of the gravitational boundary of the proton a gravitational well is found in the external region of the space. All possible orbits of the electrons pass through the well.

The proton mass forms as a result of the spherical compression of the alternating shell of the proton together with the quantised medium (Fig. 7.4). Regardless of the fact that the distance between the charges of the alternating shell of the proton is approximately $1.2\cdot10^{-16}$ m and the quanton

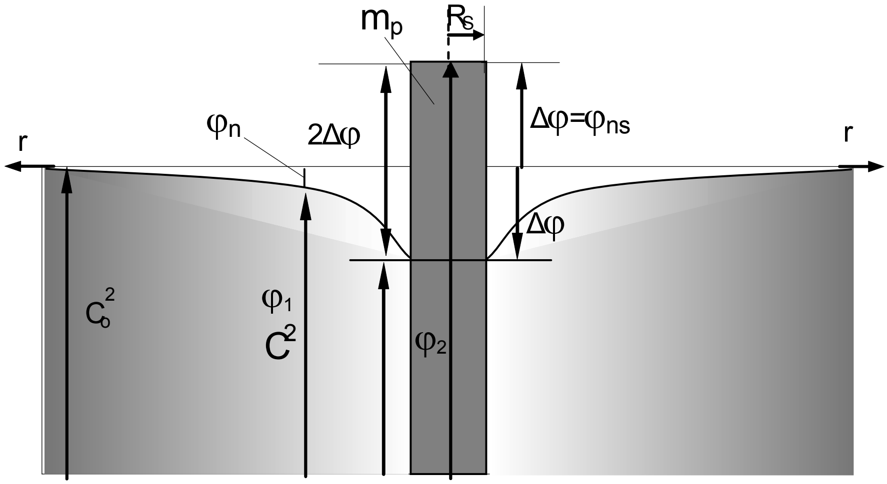

Fig. 7.5. Simplified gravitational diagram of the proton (atomic nucleus) in the form of distribution of the gravitational potentials in the spherically deformed quantised medium perturbed by mass m_p.

diameter is of the order of 10^{-25} m, the shell permits compression of the quantised medium. The effect of the electrostatic gate operates when the quantons, situated between the charges of the alternating shell in the field with a very high strength, form oriented chains which appear to be a continuation of the shell. Since the compression stress of the quantised medium by the shell is incomparably smaller in relation to the tension of the quantised medium, during movement of the proton in space the electrostatic gate does not interfere with the penetration of the medium through the proton shell. The analogue of the electrostatic gate and the effect itself have been verified reliably by the author of the book for the electrostatic field of the lattice of the alternating electrons in dosing devices of fine dispersion powders.

As a result of compression of the alternating shell of the proton inside the shell, the quantum density of the medium increases because it decreases on the external side. This has been investigated in detail in [2]. It is important to note that a gravitational well forms on the external side of the shell which represents the gravitational boundary in the medium. Since the quantum density of the medium is an analogue of the gravitational potential, the gravitational diagram in Fig. 7.5 shows the distribution of the gravitational potentials (for γ_n=1); the distribution function of this potential slightly differs from (7.27) for the electron

$$\begin{cases} \varphi_1 = C^2 = C_0^2\left(1 - \frac{R_g}{r}\gamma_n\right), \quad r \geq R_S \\ \varphi_2 = C_0^2\left(1 + \frac{R_g}{R_S}\gamma_n\right) \end{cases} \tag{7.43}$$

Equation (7.43) includes the root mean square radius $R_S = 0.8\cdot10^{-50}$ m of the proton and its gravitational radius R_g, which is a purely calculation parameter

$$R_g = \frac{Gm_p}{C_0^2} \tag{7.44}$$

Function (7.43) is sufficient for compiling the balance of the gravitational potentials inside the gravitational well of the proton (for $n = 1$) at the distance r

$$C^2 = C_0^2 - \varphi_n = C_0^2 - \frac{Gm_p}{r} \tag{7.45}$$

where φ_n is the Newton potential of the proton, m^2/s^2.

At the gravitational boundary with the radius R_S there is a 'jump' of the gravitational potentials $2\Delta\varphi= 2\varphi_{ns}$, where φ_{ns} is the Newton potential at the interface on the external side for $r = R_S$. The distribution function of the gravitational potential $\varphi_1 = C^2$ (7.44) and (7.45) inside the gravitational well is used as the basis in analysis of the behaviour of the orbital electron in the composition of the proton nucleus of the atom and was not previously taken into account in quantum mechanics.

Thus, the presence of the gravitational well at the proton nucleus of the hydrogen atoms makes it possible to link the behaviour of the orbital electron inside the gravitational well of the atomic nucleus with the fact that the gravitational well in particular is a factor of energy stabilisation of the atom as a whole and the reason for the non-radiation of the orbital electron.

7.4. Reasons for the non—radiation of the orbital electron

We discuss the simplest case of the behaviour of the orbital electron for the hydrogen atom with the proton nucleus when the electron falls on the nucleus. The gravitational well of the proton is described by the distribution of the gravitational potential of action $\varphi_1 = C^2$ (7.44) and (7.45) in the conditions of the effect of the electrical potential φ_e of the proton nucleus of the atom

$$\varphi_e = \frac{1}{4\pi\varepsilon_0}\frac{e}{r} \tag{7.46}$$

Figure 7.6 shows the conventional turn of the trajectory of the orbital electron inside the gravitation well of the proton nucleus of the atom when, regardless of the continuous change of the distance r between the electron and the proton, the orbital electron does not generate continuous electromagnetic radiation. In particular, the presence of the gravitational well must be taken into account when analysing the reasons for the non-radiation of the orbital electron. Regardless of the small gravity force in comparison with the electrical force, as already mentioned, the energy of the gravitational well is determined by the spherical deformation of the quantised medium and not by gravity [2]. The attraction of the electron to the proton is determined by the electrical interaction. However, the behaviour of the electron inside the gravitational well of the nucleus greatly differs from the behaviour in the electrical field of the nucleus, if the effect of the gravitational well is not taken into account. It is characteristic that the gravitational potential C^2 (7.45) of the proton decreases when approaching the atom nucleus and the electrical potential φ_e (7.46) increases.

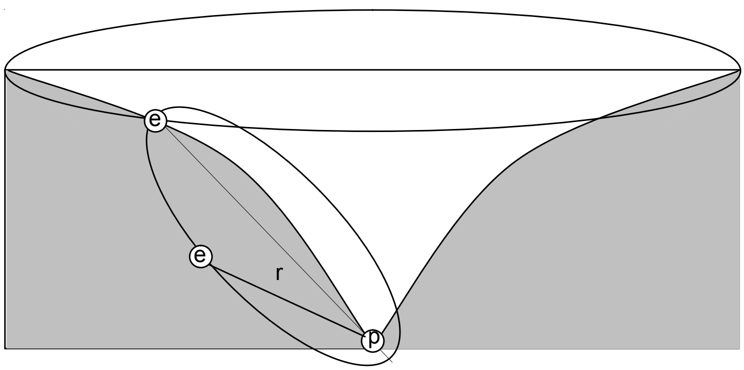

Fig. 7.6. Non-radiation of the orbital electron e in the conventional turn inside the gravitational well of the proton p of the nucleus of the atom with continuous radiation of the distance r between the electron e and the proton p.

It would appear that the total gravitational energy W_{e-p} for the electron–proton system (e–p) is determined by the energy of deformation of the quantised medium by the electron and proton as the sum of the energies of the particles:

$$W_{e-p} = (m_e + m_p)C_0^2 \tag{7.47}$$

Consequently, the fraction of the gravitational energy W_{Ge} of the electron as the elastic energy of deformation of the quantised medium, in the total gravitational energy of the atom W_{e-p} (7.47) can be taken into account by coefficient k_e. On the condition that $m_p \gg m_e$, we determine k_e and W_{Ge}

$$k_e = \frac{m_e}{m_p + m_e} \approx \frac{m_e}{m_p} \tag{7.48}$$

$$W_{Ge} = k_e W_{e-p} = \frac{m_e}{m_p + m_e}(m_e + m_p)C_0^2 = m_e C_0^2 \tag{7.49}$$

However, equations (7.47) and (7.49) were derived without considering the combined interaction of the electron and the proton when they are situated at a large distance from each other outside the gravitational well of the atom nucleus. However, when the electron and the proton come closer to a distance of short-range interaction, their spherical gravitational fields overlap each other and the proton field becomes dominant and displaces the electron into its gravitational well. In this case, the energy of the gravitational interaction of the electron–proton system with the quantised medium depends on the distance between the electron and the proton.

To determine the energy of interaction of the electron–proton system with the quantised medium, we use a new procedure taking into account that the transfer of limiting mass $m_{e\max}$ (7.8) inside the electron through its gravitational well (*a–b–c*) (Fig. 7.1) with a depth equal to the Newton potential φ_n of the electron at the distance $r_{e1} = r_e + R_e \approx r_e$ determines the gravitational rest energy W_0 (7.28) of the electron:

$$W_0 = \int_0^{-\varphi_n} m_{e\max} d\varphi == m_{e\max}(-\varphi_n) = -\frac{C_0^2 r_e}{G}\frac{Gm_e}{r_e} = -m_e C_0^2 \tag{7.50}$$

Actually, the hidden mass $m_{e\max}$ is found inside the electron in the rest state. The transfer of the mass into the depth of the electron is associated with work W_0 (7.50). Attention should be given to the fact that the Newton potential φ_n in the balance of the gravitational potentials (7.45) of the electron has the negative sign which also determines the rest energy W_0 (7.15) as energy with a negative sign. Usually, the rest energy (7.28) is used with the positive sign. The sign of the energy is important only when forming an energy balance which for the free electron is determined by the balance of the gravitational potentials inside its gravitational well

$$C^2 = C_0^2 - \varphi_n = C_0^2 - \frac{Gm_e}{r} \tag{7.51}$$

The distribution of the rest energy W_0 (7.15) of the electron as the energy of deformation of the quantised medium inside the gravitational well determines the equivalence of the gravitational and electrical W_e energies of the electron [4]

$$W_0 = W_e = m_e C_0^2 \frac{r_e}{r} = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r} \tag{7.52}$$

Taking into account the negative sign of gravitational energy W_0 (7.50) of the electron, it may be assumed that its rest energy is completely balanced by electrical energy $W_e - W_0 = 0$.

For the electron moving from the rest state with the speed *v*, taking into account the effect of the principle of spherical invariance for the elementary particles, we introduce the normalised relativistic factor γ_n (7.7) into the equations (7.50), (7.51) and (7.52) which also takes into account the kinetic energy of the orbital electron

$$W = W_0 \gamma_n = \gamma_n \int_0^{\varphi_n} m_{max} d\varphi = m_{max} \varphi_n \gamma_n = m_0 C_0^2 \gamma_n \tag{7.53}$$

$$C^2 = C_0^2 - \varphi_n \gamma_n = C_0^2 - \frac{G m_e}{r} \gamma_n \tag{7.54}$$

$$W = W_0 \gamma_n = W_e \gamma_n = m_e C_0^2 \frac{r_e}{r} \gamma_n = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r} \gamma_n \tag{7.55}$$

Equation (7.54) makes it possible to form the balance of the total energy of the free electron in the quantised medium by multiplying (7.54) by m_{emax} (7.8) with (7.50) taken into account

$$m_{e\max} C^2 = m_{e\max} C_0^2 - m_{e\max} \varphi_n \gamma_n = m_{e\max} C_0^2 - m_{e\max} \frac{G m_e}{r} \gamma_n \tag{7.56}$$

Equation (7.56) includes:

– the limiting energy of the electron W_{emax} (7.9)

$$W_{e\max} = m_{e\max} C_0^2 = \frac{C_0^4}{G} r_e \tag{7.57}$$

– the hidden energy of the electron W_c

$$W_c = m_{e\max} C_0^2 \tag{7.58}$$

– the observed electron energy W (7.55)

$$W = m_{e\max} \varphi_n \gamma_n = \frac{C_0^2}{G} r_e \frac{G m_e}{r} \gamma_n = m_e C_0^2 \gamma_n \frac{r_e}{r} \tag{7.59}$$

The energy of the electron W (7.59) is determined by the total energy (7.53) of deformation of the quantised medium inside the gravitational well of the electron at $r_e = r$

$$W = m_e C_0^2 \gamma_n \tag{7.60}$$

Substituting (7.57), (7.58), (7.60) into (7.56), we can express the total balance of energy of the free electron in the quantised medium

$$W = W_{e\max} - W_c$$

$$m_e C_0^2 \gamma_n = \frac{C_0^4}{G} r_e - m_{e\max} C^2 \tag{7.61}$$

The total energy balance (7.61) of the free electron in the quantised medium indicates that its observed energy is determined by the difference between the limiting energy W_{emax} (7.57) and hidden energy W_c (7.58). With the increase of the speed of the free electron the hidden energy is transferred into the observed region, increasing the depth of the gravitational well of the electron in the quantised medium.

For the orbital electron, which is not free, it is necessary to re-examine its total energy balance (7.61), taking into account the interaction of the orbital electron with the proton nucleus of the atom. For this purpose, we use the previously mentioned procedure for the case of the bonded orbital electron in the composition of the atom and determine the gravitational energy W_{Ge-p} of the electron–proton system in transfer of the limiting mass $m_{\max}$ (7.8) of the electron through the gravitational well of the proton with a depth φ_n (7.45) as a result of particles coming closer to the distance r by analogy with (7.50)

$$W_{Ge-p} = m_{e\max}(-\varphi_n)\gamma_n = -\frac{C_0^2}{G} r_e \frac{Gm_p}{r} \gamma_n = -m_p C_0^2 \gamma_n \frac{r_e}{r} \tag{7.62}$$

As indicated by (7.62), the functional dependence of the gravitational energy W_{Ge-p} of the interaction of the electron–proton system with the quantised medium on the distance r between the particles is determined by the energy $m_p C_o^2 \gamma_n$ of the proton and the classic electron radius r_e.

The fraction of the gravitational energy W_{Ge} of the electron in the electron–proton system W_{Ge-p} (7.62) is determined by the multiplier k_e (7.48)

$$W_{Ge} = k_e W_{Ge-p} = -\frac{m_e}{m_p} m_p C_0^2 \gamma_n \frac{r_e}{r} = -m_e C_0^2 \gamma_n \frac{r_e}{r} \tag{7.63}$$

The normalised relativistic factor γ_n in (7.63) takes into account the speed of the orbital electron and its kinetic energy on the orbit in the composition of the gravitational energy (7.63) of the electron–proton system. When moving away from the proton, the energy (7.63) decreases and at infinity turns to 0.

It is interesting to note that the gravitational energy of the orbital electron W_{Ge} (7.63) in the composition of the proton nucleus of the atom as a function of the distance between the electron and the proton is determined like the gravitational energy (7.59) of deformation of the medium of the gravitational well of the free electron. The difference lies in the fact that the energy W_{Ge} (7.63) is characterised by the approach of the electron to the proton and energy W (7.59) by movement from the electron to the quantised medium.

The gravitational energy of the orbital electron W_{Ge} is the negative energy because the Newton potential φ_n of the proton in the balance (7.45) is negative and reduces the gravitational potential of action C^2 on approach to the proton. The negative value of energy (7.63) means that this component of the gravitational energy reduces the energy of the electron in its energy balance for the electron–proton system by the value W_{Ge} when these particles come together.

The equivalence of the gravitational and electrical energies (7.55) of the free electron is also found for the orbital electron in the composition of the proton nucleus when its gravitational energy W_{Ge} (7.63) in the electron–proton system is equivalent to the electrical energy W_e of the interaction of the electron and proton charges

$$W_e = W_{Ge} = m_e C_0^2 \gamma_n \frac{r_e}{r} = m_e C_0^2 \gamma_n \frac{1}{4\pi\varepsilon_0} \frac{e^2}{m_e C_0^2} \frac{1}{r} = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r} \gamma_n \quad (7.64)$$

$$W_e = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{r} \gamma_n \quad (7.65)$$

Equation (7.64) can be presented in a more convenient form of the energy balance for the orbital electron in the electron–proton system

$$W_e - W_{Ge} = 0$$

$$\frac{1}{4\pi\varepsilon_0} \frac{e^2}{r} \gamma_n - m_e C_0^2 \gamma_n \frac{r_e}{r} = 0 \quad (7.66)$$

Equation (7.66) was derived by the previously mentioned calculations which show that the orbital electron in the system of the proton nucleus (and also for any atom nucleus) should not radiate during the change of the distance r between the electron and the atom nucleus. In fact, when an atom falls on the nucleus the increase of the electrical energy of the interaction of the electron with the nucleus on approach to the nucleus is fully compensated by the equivalent decrease of the gravitational energy of the system.

Thus, the atom is a self-regulating system whose energy is maintained constant because in the case of the orbital electron only the energy of its interaction with the quantised medium as the rest energy $W_0 = -m_e C_0^2$ (7.50) remains unchanged and determines the energy balance of the orbital electron

$$
\begin{aligned}
&W_0 = -m_e C_0^2 + W_e - W_{Ge} = -m_e C_0^2 = \text{const} \\
&-m_e C_0^2 + \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}\gamma_n - m_e C_0^2 \frac{r_e}{r}\gamma_n = \\
&= \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}\gamma_n - m_e C_0^2\left(1 + \frac{r_e}{r}\gamma_n\right) = \text{const}
\end{aligned}
\tag{7.67}
$$

The equivalence of the gravitational energy W_{Ge} (7.64) and the electrical energy W_e (7.65) of the orbital electron of the electron–proton system in the composition of the atom whose energy (7.61) remains constant for any coordinate r of the electron on the orbit explains why the orbital electron does not generate continuous electromagnetic radiation. The problem may be formulated more accurately, assuming that the atom is a unique energy system which should not radiate energy continuously because of the complete balancing of its electrical and gravitational components, irrespective of the distance between the orbital electron and the atom nucleus.

However, the atom does emit photons discretely. If the physics of the atomic nucleus previously faced the problem of explaining the reasons for non-radiation of the orbital electron in the composition of the atom, it is now necessary to find the reasons for its photon radiation. It may be assumed the variation of the gravitational potential C^2 (7.45) of the action of the proton that inside the gravitational well changes the rest energy $W_0 = m_e C_0^2$ of the electron as a result of the fact that constant C_0^2 should be substituted by function C^2. We calculate the variation of the rest energy ΔW_0 of the orbital electron inside the gravitational well of the proton for the maximum case in which the electron comes closer to the proton to the distance of, for example, $r = 2r_e$

$$
\Delta W_0 = m_e C_0^2 - m_e C^2 = m_e \varphi_n = \frac{G m_e m_p}{2r_e} = 1.8 \cdot 10^{-53}\,\text{J} = 1.1 \cdot 10^{-36}\,\text{eV} \tag{7.68}
$$

As indicated by (7.68), the variation of the rest energy of the orbital electron inside the proton nucleus of the atom is so small that it cannot cause photon radiation of the electron. Possibly, the energy (7.68) is indeed emitted by the atom but the nature of this radiation is not yet known, it may be gravitational radiation. However, this constantly acting radiation with the frequency of rotation of the electron at the orbit of the atom cannot be measured by the currently available measurement method.

Thus, the investigation show that the atom is a balanced energy system which should not emit photon radiation is the result of changes of the electrical energy of the electron on the atom orbit. Prior to examine the reasons for the radiation of the atom, it is necessary to introduce a number of additions into the calculations described previously and relating to the electrical energy W_e (7.65) of the orbital electron in the relativistic region.

The effect of the gravitational factor γ_n (7.7) on the electrical energy W_e of the relativistic electron can be regarded as the variation of the relative dielectric permittivity ε_1 of the quantised medium of the electron–proton system in the range of the speeds close to the speed of light:

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}\gamma_n = \frac{1}{4\pi\varepsilon_0\varepsilon_1}\frac{e^2}{r} \tag{7.69}$$

$$\varepsilon_1 = \frac{1}{\gamma_n} \tag{7.70}$$

For the non-relativistic speeds $\varepsilon_1 \approx 1$. The variation of dielectric permittivity ε_1 (7.70) of the quantised medium with the increase of the speed of the electron is determined by the increase of the tension of the medium inside the gravitational well of the electron (Fig. 7.1) which in turn is situated inside the gravitational well of the atom nucleus (Fig. 7.5). Attention should be given to the fact that the relative dielectric permittivity $\varepsilon_1 < 1$ since it is connected with the tension of the quantised medium inside the gravitational well.

In the range of non-relativistic speeds for $v \ll C_0$, expanding the factor γ_n (7.7) into a series and rejecting insignificant terms, from (7.67) we obtain the balance of the energy of the orbital electron

$$\gamma_n \approx 1 + \frac{v^2}{2C_0^2} \tag{7.71}$$

$$\begin{aligned} W_0 &= -m_e C_0^2 + \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}\left(1 + \frac{v^2}{2C_0^2}\right) - m_e C_0^2 \frac{r_e}{r}\left(1 + \frac{v^2}{2C_0^2}\right) = \\ &= -m_e C_0^2 + \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r} - m_e C_0^2\frac{r_e}{r} + \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}\frac{v^2}{2C_0^2} - \frac{m_e v^2}{2}\frac{r_e}{r} = \text{const} \end{aligned} \tag{7.72}$$

Equation (7.72), like (7.67), shows that the electrical energy W_e of the orbital electron in its energy balance has an additional term which depends on the electron speed, and the kinetic energy of the electron as, in addition to the speed parameter, a connection for the distance between the electron and the proton nucleus. This relates not only the simplest hydrogen atom but also to all atomic systems.

That the atom is completely balanced from the energy viewpoint was proven in the theory of Superintegration, introducing the corrections associated with the deformation of the quantised medium by the atomic nucleus and the electron–proton system. In fact, the radial electrical field of the electron on approach to the proton nucleus transformed to the field of the electrical dipole of the electron–proton system, disrupting the spherical symmetry of the field of the electron. All this takes place inside the gravitational well of the proton. As a result, an increase of the electrical energy of the electron–proton system when the two come closer together is fully compensated by the decrease of the gravitational energy of the system which is not connected with the gravity fields.

The energy-balanced atom does not generate continuous radiation regardless of the nature of the trajectory of the orbital electron with the orbit of the electron having a complicated trajectory with the variable speed and acceleration. These complicated orbit are perceived as the electron cloud in the composition of the atom.

The completely compensated electrical and gravitational components of the orbital electron in the composition of the atom were not examined in the physics of elementary particles and the atomic nucleus. All the calculations were carried out for the homogeneous and isotropic space-time inside the atom, without taking into account its deformation inside the gravitational well of the atom nucleus. Naturally, the incomplete model of the atom created considerable difficulties in quantum theory.

Only by taking into account the heterogeneity of the quantised medium, determined by its tensioning inside the gravitation well and compression inside the proton (neutron) and the electron in the composition of the atom is possible to carry out more accurate calculations of the atom, corresponding to the experimental observations. Maxwell electrodynamics does not work inside the atom. This is determined by the fact that the Maxwell energetics and, more accurately, balancing of its electrical and gravitational components of the atom, is based on the super strong electromagnetic interaction (SEI) which determines the electromagnetic nature of all interactions, and not allowing the atom to continuously radiate energy. In fact, the above calculations recover the classic nature of quantum theory, confirming Einstein's believe that the quantum theory should lead to the deterministic nature of the laws of quantum physics.

7.5. Reasons for proton radiation of the orbital electron

In the previous section, it was shown that the orbital electron on any orbit cannot continuously radiate electromagnetic energy regardless of the complexity of its trajectory. Bohr postulated the stationary condition of the atom in which the atom does not radiate. This Bohr postulate has now been strictly substantiated.

On the other hand, Bohr also postulated that the atom emits discretely the photon energy at the moment of transition from a higher to a lower orbit. The energy of photon radiation at the moment of such a transition is determined by the difference of the energy state (7.2) of the orbital electron on the given orbits. The incorrectness of this assumption already becomes clearly evident when explaining the reasons for non-radiation of the orbital electron when the concept of the electron orbit requires efficient explanation. As already mentioned, the wave mechanics excluded the very concept of the electron orbit, replacing it with a probability electron cloud. Therefore, the Bohr postulate, describing the moment of radiation of the photon in transition from one orbit to another, is governed by the Heisenberg uncertainty principle in which the coordinate of the electron trajectory at the moment of radiation is not determined.

In fact, returning to examining only one turn of the electron orbit, even if the orbit is non-stationary, it is not possible to determine the coordinate of the trajectory when the electron should 'jump' from the orbit and emit a photon (Fig. 7.6). All the coordinates of the electron orbit are equally important because in accordance with the energy balance (7.67) of the orbital electron in the composition of the atom, the electron is not capable of emitting a photon. This means that the reason for the photon radiation of the orbital electron cannot be the jump of the electron to a lower orbit because this contradicts the energy balance (7.67). This leaves the second non-contradicting assumption according to which the transition of the electron to another orbit takes place already after photon radiation. This transition of the electron is a consequence whose reason must be determined and justified.

It was shown in [3] that the photon, as a two-rotor wave particle, can form only in the region of relativistic speeds. This means that for the orbital electron to emit a photon, the electron should be accelerated to a speed very close to the speed of light. The atom, as a self-regulating system, must not permit the relativistic increase of the mass of the orbital electron in order to avoid disrupting the mass of the atom as a whole. Partially, this is confirmed by the energy balance (7.67) of the orbital electron, showing that the Maxwell electrodynamics does not operate inside the atom in interaction of the orbital electron with its nucleus. The uniqueness of the structure of the atom should also be manifested in the fact that the relativism laws cannot operate inside the atom in the sense that they should lead to an unlimited increase of the mass of the orbital electron in the speed range close to the speed of light.

Naturally, the electricity, magnetism and gravitation are combined together inside the atom, and the radiation spectrum can be linked quite accurately with the results of calculations through the variation of the electrical component. As it has been shown, the specific features of the behaviour of the orbital electron in the composition of the atom are such that in principle the atom should not radiate with the variation of the electrical component. Therefore, the main reason for the photon radiation of the orbital electron in accordance with (7.2) can only be its mass defect. In nuclear reactions, the concept of photon radiation as a result of the mass defect of the nucleus has been generally accepted and is not doubted. It is now necessary to show that the mass defect of the electron is also the reason for photon radiation of the orbital electron.

It is well known that the electron moving uniformly and in a straight line does not radiate. Radiation is the result of acceleration (deceleration) of the electron. In experiments, this has been confirmed by bremsstrahlung and synchrotron radiation [16]. It is fully logical to assume that there is some critical acceleration $\mathbf{a}_{cr}$ of the orbital electron which determines the moment of its photon radiation. In this case, the radiation momentum is determined by the condition of reaching the critical acceleration by the electron ($\mathbf{a}$ is electron acceleration)

$$\mathbf{a} \geq \mathbf{a}_{cr} \tag{7.73}$$

As already mentioned, the electron mass is determined by the elastic energy of spherical deformation of the quantised medium. Evidently, the mechanism of photon radiation in acceleration of the electron above the critical value (7.73) is determined by the disruption of spherical symmetry of its gravitational field which is characterised by some critical displacement of its point charge in relation to the centre of the spherical gravitational boundary of the electron, disrupting its symmetry. To restore the symmetry of the field, the electron should release its asymmetric part in the form of the energy of elastic deformation of the quantised medium to photon radiation. This determines the mass defect of the orbital electron which after releasing part of the energy into radiation changes the trajectory of the orbit to a lower one, forming a new electron cloud from the trajectories around the atomic nucleus.

Previously, the state of the theory of the orbital electron was such that it was not possible to determine the moment of radiation of the electron on its trajectory. Assuming that the moment of radiation is associated with some critical acceleration $\mathbf{a}_{cr}$ (7.73) of the orbital electron in the range of relativistic speeds, it may be assumed that the critical acceleration is reached only at the surface of the atomic nucleus. Only at the surface of the core can the electron reach the relativistic speed and change the trajectory in the vicinity of the nucleus, ensuring the required radius of the trajectory and critical acceleration. Consequently, the solution of the problem of radiation of the orbital electron is reduced to determining the critical acceleration $\mathbf{a}_{cr}$, directly linked with the instantaneous speed of the electron and the radius of its orbit in the vicinity of the atomic nucleus.

Figure 7.7 shows the diagram of the radiation of the photon ν by the orbital electron *e* on the proton *p* nucleus of the atom. This scheme is an analogue of synchrotron radiation when the photon is emitted as a result of the electron reaching critical acceleration $\mathbf{a}_{cr}$ in movement of the electron along the radius. The direction of photon radiation ν coincides with the vector of the speed of the electron **v** at the moment of radiation, possibly with a small angle of the raster. The photon behaves as part of the electron mass, selecting the direction of its movement which coincides with the direction of movement of the electron at the moment of radiation. The recoil pulse of the photon to the electron is directed against the direction of movement of the electron, reducing its speed and determining the transfer of the electron from the excited state to the stationary orbit.

The concept of radiation of the orbital electron on the atom nucleus makes it possible to concretise the very moment of radiation when the position of the atom at the moment of radiation is known. Figure 7.7 shows a set of instantaneous trajectories where one of them corresponds to the stationary orbit without photon radiation, and the others to excited orbits, capable of radiation by the electron of a photon with a specific energy and frequency. Naturally, the electron orbits are quantised because they

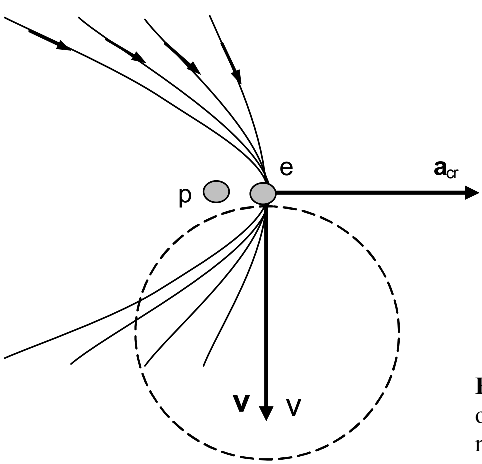

Fig. 7.7. Radiation of a photon ν by the orbital electron *e* at the proton *p* atom nucleus.

determine the quantised state of its speed and the radius of the trajectory in the vicinity of the atomic nucleus.

To calculate the speed parameters of the electron in the vicinity of the proton nucleus, we examine the case of nonrelativistic incidence of the electron on the proton along the axis X with the origin of the coordinates on the proton. It is important to determine the speed of the electron at the moment of coming closer to the proton which is determined by the electrical force $\mathbf{F}_e$ of the Coulomb attraction of the electron and the proton:

$$\mathbf{F}_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{x^2}\mathbf{1}_x \tag{7.74}$$

The equation of movement of the electron falling on the proton is described by the well-known nonrelativistic dynamics equation

$$\mathbf{F}_e = m_e\frac{d\mathbf{v}}{dt}, \quad \text{or} \quad \mathbf{F}_e = m_e v\frac{d\mathbf{v}}{dx} \tag{7.75}$$

Substituting (7.74) into (7.75) and separating the variables we can write the differential equation with the integration limits with respect to speed from 0 to v, and with respect to the distance from $x_0 = 0$ to $x = 2r_e$, where $2r_e$ is the minimum distance between the centres of the charges of the electron and the proton

$$\int_0^v v\,dv = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{m_e}\int_{x_o}^{2r_e}\frac{dx}{x^2} \tag{7.76}$$

Integrating (7.76)

$$\frac{v^2}{2} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{m_e}\left(\frac{1}{2r_e} - \frac{1}{x_0}\right) \tag{7.77}$$

Accepting that $r_e \ll x_0$, we multiply the right-hand part of (7.77) by C_0^2/C_0^2, and taking into account the equation for the classic radius of the electron r_e, we determine the speed of incidence of the electron in the vicinity of the proton

$$v = C_0 \tag{7.78}$$

As indicated by the solution of (7.78), even when falling from a small height on the proton, the nonrelativistic electron does reach the speed of light which would appear to be not realistic from the classic viewpoint. On the other hand, the results show that under the condition of radiation on an atom nucleus all orbital electrons are relativistic and the dynamics equation (7.75) should include the normalised relativistic factor γ_n (7.7). This is determined by the the speed of the electron being independent of the coordinate axes when the electron comes very close to the proton nucleus. However, the electron falls on the proton along a complicated trajectory (not a straight line), including the radial and tangential components.

The relativistic equation of the dynamics of the orbital electron should include the relativistic factor γ_n (7.7) in (7.75) taking into account the reduced mass m'_e of the orbital electron determined below:

$$\mathbf{F}_e = \frac{d(m'_e \mathbf{v} \gamma_n)}{dt}, \quad \text{or} \quad \mathbf{F}_e = v\frac{d(m'_e \mathbf{v} \gamma_n)}{dx} \tag{7.79}$$

The solution of the equation (7.79) should be connected with the total energy balance (7.67) of the orbital electron replacing the notation of the distance r by x

$$W_0 = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{x}\gamma_n - m_e C_0^2\left(1 + \frac{r_e}{x}\gamma_n\right) = \text{const} \tag{7.80}$$

Equation (7.80) includes the electrical energy W_e (7.69) of the interaction of the electron with the proton and the total gravitational energy W_G of the orbital electron in the composition of the proton nucleus of the atom

$$W_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{x}\gamma_n \tag{7.81}$$

$$W_G = -m_e C_0^2\left(1 + \frac{r_e}{x}\gamma_n\right) \tag{7.82}$$

From (7.81) we determine the electrical energy $\mathbf{F}_e$, acting on the orbital electron from the side of the proton charge

$$\mathbf{F}_e = \frac{dW_e}{dx} = -\frac{1}{4\pi\varepsilon_0}\frac{e^2}{x^2}\gamma_n \mathbf{1}_x \tag{7.83}$$

From (7.82) we determine the reduced mass m'_e of the orbital electron in the composition of the proton atom of hydrogen

$$m'_e = \frac{W_G}{C_0^2} = -m_e\left(1 + \frac{r_e}{x}\gamma_n\right) \tag{7.84}$$

Substituting (7.34) into (7.78) we obtain

$$\mathbf{F}_e = v\frac{d(m'_e \mathbf{v}\gamma_n)}{dx} = -m_e v\frac{d\left(1 + \frac{r_e}{x}\gamma_n\right)\mathbf{v}\gamma_n}{dx} \tag{7.85}$$

Substituting (7.83) into (7.85) and after separating the variables, we obtain the relativistic equation of dynamics of the orbital electron, whose solution should be found in relation to speed v

$$\frac{v}{\gamma_n} d\left(1+\frac{r_e}{x}\gamma_n\right)\gamma_n v = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{m_e}\frac{dx}{x^2} \quad (7.86)$$

It is not possible to completely separate the variables with respect to x in (7.86). Taking into account that the solution (7.86) depends on the value of x in the vicinity of the proton, equation (7.86) can be simplified in the first approximation, accepting the minimum distance $x = 2r_e$ in its left part

$$\frac{v}{\gamma_n} d\left(\gamma_n v+\frac{1}{2}\gamma_n^2 v\right) = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{m_e}\frac{dx}{x^2} \quad (7.87)$$

In the second approximation (7.97), the relativistic factor can be taken away from below the differential sign. Consequently, in integration taking into account that the integral of the right-hand part of (7.87) has already been determined as $C_0^2/2$ in (7.77), we obtain

$$\int v dv + \frac{1}{2}\int \gamma_n v dv = \frac{C_0^2}{2} \quad (7.88)$$

Equation (7.88) can be simplified by replacing the normalised relativistic factor γ_n (7.7) by the conventional relativistic factor γ, making more severe the conditions at which the limiting parameters of the relativistic electrons are not restricted

$$\gamma_n \approx \gamma = (1 - v^2/C_0^2)^{-0.5} \quad (7.89)$$

Substituting (7.89) into (7.88) gives

$$\int v dv + \frac{C_0}{2}\int (C_0^2 - v^2)^{-0.5} v dv = \frac{C_0^2}{2} \quad (7.90)$$

Integrating (7.19) we obtain the equation linking the speed of the orbital electron in the vicinity of the proton nucleus of the atom with the speed of light at the minimum distance $x = 2r_e$

$$\frac{v^2}{2} - \frac{C_0}{2}\sqrt{C_0^2 - v^2} = \frac{C_0^2}{2} \quad (7.91)$$

The solution of (7.91) includes the real and imaginary value of the speed. It is interesting to consider the real value of the speed

$$v = C_0 \quad (7.92)$$

Verification of the validity of the solution (7.92) by substitution into (7.91) shows that the solution of (7.92) is accurate. It would appear that we have obtained a paradoxic result, identical with (7.78), when the orbital electron is capable of reaching the speed of light in the composition of the atom even when solving the relativistic equation. In fact, the limiting speed of the orbital electron is slightly higher than the speed of light because a number of assumptions has been made in the solutions

$$v = C \leq C_0 \tag{7.93}$$

The speed of the electron (7.93) in the relativistic range is denoted through $C \leq C_0$ because the result (7.92), as already mentioned, has been obtained with certain assumptions, simplifying the solution of the equations. However, even if all the assumptions are removed because of the large volume of complicated computations, the speed (7.93) of the orbital electron in the vicinity of the atomic nucleus is close to the speed of light, albeit slightly lower. This is not important now. It is important to note that the solution of the nonrelativistic (7.74) and relativistic (7.79) equations of the dynamics of the orbital electron results in almost identical results (7.78) and (7.92).

On the other hand, the arbitrarily selected parameter of the distance between the electron and the proton $x = 2r_e$ is limiting, with the particles not being able to come closer together, regardless of the fact that the calculation radius of the proton $0.8 \cdot 10^{-15}$ m is slightly smaller than the classic radius of the electron $r_e = 2.8 \cdot 10^{-15}$ m. It would appear that there is still some gap in which they can come closer together. However, it is evident that, as already mentioned, this gap is determined by the forces of anti-gravitational repulsion which prevent the proton from capturing the electron, except for an unlikely effect of electron capture.

The classic solution for the speed of the orbital electron when approaching the proton nucleus of the atom to the distance $x = 2r_e$ can be determined from the relativistic equation for the energy balance. In this case, the increase of the energy of the orbital electron in acceleration in the electrical field regardless of the form of its trajectory is determined by the difference of the electrical potentials φ_e of the proton field through which the electron has passed:

$$m_e C_0^2 (\gamma - 1) = e\varphi_e$$
$$\text{where } e\varphi_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{2r_e} = \frac{m_e C_0^2}{2} \tag{7.94}$$

The solution of (7.94) is

$$\gamma = \frac{3}{2}, \quad v = 0.75C_0 \tag{7.95}$$

It would appear that the solution $v = 0.75\ C_0$ (7.95) corresponds to the condition in which the speed of the relativistic electron is relatively high but considerably lower than the speed of light. However, the solution (7.95) was obtained from the incomplete energy balance of the electron (7.94) which does not correspond to the balanced nature of the energy of the atom, as the total balance (7.67) giving the solution $v = C \le C_0$ (7.92), (7.93).

The fact that the speed of the orbital electron reaches the speed of light in the solution $v = C \le C_0$ (7.93) or is very close to the speed of light, does not contradict the model of synchrotron radiation of the electron, and it was shown by experiments that the electron is capable of radiation only in the range of relativistic speeds, close to the speed of light. This position is also in agreement with the condition of radiation of the electron only at relativistic speeds [3]. The orbital electron cannot pulled into the atom at the moment of radiation. However, the radiation of the electron in a synchrotron has been studied quite extensively, and the synchrotron model, as the model of radiation of the orbital electron with corrections for the energy balancing of the atom, shows further potential for development [16].

Naturally, the results showing that the speed C (7.93) of the orbital electron is very close to the speed of light would cause objections because the theory of relativity does not enable the electron to reach the speed of light. However, the theory of relativity was not completed by Einstein and was completed in the theory of EQM and Superintegration not only as the theory of gravitation but also as the theory of integration of gravitation and electromagnetism and also of all other fundamental interactions. The theory of EQM and Superintegration confirms the assumptions of the theory of relativity, assuming that the orbital electron cannot exceed the speed of light, and this condition is fulfilled in the resultant solution (7.93).

In the rectangular coordinates (x, y, z) the vector of speed $\mathbf{C}$ (7.93) of the orbital electron at the moment of radiation can be expanded with respect to the unit vectors **i, j, k**

$$\mathbf{C} = v_x\mathbf{i} + v_y\mathbf{j} + v_y\mathbf{k} \tag{7.96}$$

$$\mathbf{C} = \frac{\partial x}{\partial t}\mathbf{i} + \frac{\partial y}{\partial t}\mathbf{j} + \frac{\partial z}{\partial t}\mathbf{k} \tag{7.97}$$

The modulus of speed C and its direction $\mathbf{n}_c$ are determined taking into account (7.96) or (7.97)

$$C = \sqrt{v_x^2 + v_y^2 + v_z^2} \tag{7.98}$$

$$\mathbf{n}_c = \frac{\mathbf{C}}{C} = \frac{v_x\mathbf{i} + v_y\mathbf{j} + v_y\mathbf{k}}{\sqrt{v_x^2 + v_y^2 + v_z^2}} \tag{7.99}$$

There is another important question which requires explanation. When the electron reaches the speed of light $C \approx C_0$, its mass should reach the limiting value (7.8)

$$m_{e\max} = m_e \gamma_n = \frac{C_0^2}{G} r_e = 3.8 \cdot 10^{12}\,\text{kg} = 4.2 \cdot 10^{42} m_0 \quad \text{at} \quad v = C_0^2 \tag{7.100}$$

However, the experiments have not indicated any increase of the mass of the atom as a result of the colossal increase of the mass (7.99) of the orbital electron when the electron should become periodically a massive nucleus and the proton an orbital particle, and vice versa. Therefore, it turns out that the atom does not show any relativistic increase of the mass of the orbital electrons. This only confirms the validity of the complete balancing of the atom energy (7.67) which is maintained constant regardless of the distance between the electron and the proton and also the speed of the orbital electron. The atom is a complicated self-regulating system where the radial electrical field of the orbital electron is responsible for the formation of its mass. When the electron and the proton come closer together, their fields form the field of the electrical dipole and the increase of the energy of this field results in the stabilisation of the mass of the relativistic electron, ensuring energy balance (7.67).

Naturally, the balancing of the energy (7.67) of the orbital electron in the composition of the atom suggests that the electron orbits of the atom are not ballistic from the classic viewpoint in which the movement of the particle (solid) in the central force field of attraction is not described by circular or elliptical orbits [6]. Historically, the theory of the atom, starting with the Bohr atom, repeated initially the circular planetary trajectories of the electron orbits and subsequently transferred to elliptical orbits, on the basis of ballistic calculations. However, it turned out that the model of the Bohr atom is too simplified and does not explain the entire radiation spectrum. In the final analysis, the wave mechanics arrived at the statistical model of the orbital cloud in the composition of the atom when the electron appears to get lost (dissolve) in the orbital cloud, taking into account the uncertainty principle.

Now the Superintegration theory returns fully determined parameters to the atom model and it is possible to concretise the orbits of the atom which are not ballistic in the classic sense of the meaning. The ballistics of the orbital electron is corrected not only by the energy balancing of the atom but also by the additional momentum received by the electron in the vicinity of the proton nucleus from the tangential component of the electrical field of the alternating shell of the proton (Fig. 7.4). In addition to this, in the vicinity of the proton nucleus the orbital electron is subjected to the effect of the forces of anti-gravitational repulsion preventing the electron from falling on the proton. In the final analysis, the trajectory of the electron orbit is complicated and has not as yet been calculated. However, it is now already possible to propose the nature of the trajectory of the orbital electron, taking into account that its radiation takes place in the immediate vicinity of the nucleus.

Figure 7.8 shows the trajectory of the orbital electron *e* in relation to the proton nucleus *p* of the atom (a) and the electron cloud of the stationary orbit around the nucleus (b). It is the trajectory of the electron falling on the nucleus when the vertical component of the speed in the apogee is equal to 0 and the speed in the vicinity of the proton nucleus reaches the maximum value $v = C \leq C_0$ (7.92). If we examine the probability parameters of the position of the electron on the orbit, it is quite clear that the electron can be detected in most cases in the region of small speeds at a large distance from the nucleus and this determines the most probable region in the form of the probability electron cloud. This is in agreement with the main assumptions of wave mechanics. However, the Superintegration theory permits the nature of electron orbits to be concretised and, most importantly, concretise the moment of radiation of the electron.

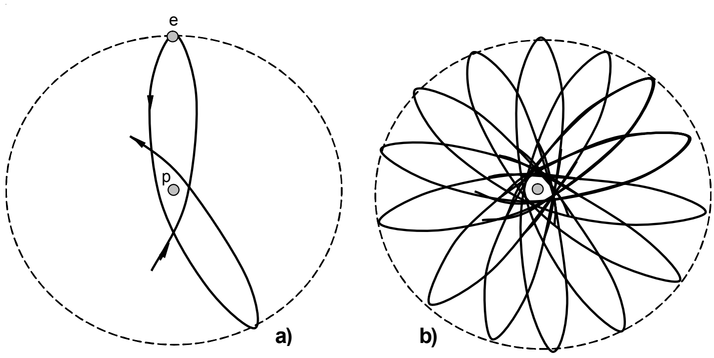

Fig. 7.8. Trajectory of the orbital electron *e* in relation to the proton nucleus *p* of the atom (a) and the electron cloud of stationary orbits around the nucleus (b).

It can already be claimed that the trajectories of the orbital electron are not situated in the same plane because the additional momentum, received by the electron as a result of the effect of the electrical field of the alternating shell of the proton nucleus, has a directionality vector. It appears that one turn of the orbital electron around the nucleus is positioned in the plane of the orbit but already the next turn changes of the position of the plane of the electron orbit in space. The planes of the two orbits 1 and 2 in the rectangular coordinate system can be expressed by the initial coordinates of the point (x_{01}, y_{01}, z_{01}) and (x_{02}, y_{02}, z_{02}) situated in different planes and the parameters of the vectors $\mathbf{N}_1(A_1,B_1,C_1)$ and $\mathbf{N}_2(A_2,B_2,C_2)$ perpendicular to the given planes, respectively [17]:

$$\begin{aligned} &A_1x + B_1y + C_1z + D_1 = 0 \\ &D_1 = -(A_1x_{01} + B_1y_{01} + C_1z_{01}) \end{aligned} \tag{7.101}$$

$$\begin{aligned} &A_2x + B_2y + C_2z + D_2 = 0 \\ &D_2 = -(A_2x_{02} + B_1y_{02} + C_1z_{02}) \end{aligned} \tag{7.102}$$

The orbital angle $\varphi_{1\text{-}2}$ between the planes is important, i.e., the angle of rotation of the plane of the orbit for the turn of the orbital electron around the atomic nucleus:

$$\cos\varphi_{1-2} = \pm\frac{A_1A_2 + B_1B_2 + C_1C_2}{\sqrt{A_1^2 + B_1^2 + C_1^2}\sqrt{A_2^2 + B_2^2 + C_2^2}} \tag{7.103}$$

The presence of the orbital angle φ_{1-2} (7.103) of rotation of the orbital plane of the electron can be substantiated only if the atomic nucleus transfers the additional nuclear momentum $\mathbf{p}_a$ to the orbital electron. The direction of the vector of this pulse does not agree with the direction of speed $\mathbf{C}$ of the electron (7.96)

$$\mathbf{p}_a = \sum_{t_0}^{t} \mathbf{F}_a(t)t \tag{7.104}$$

The nuclear momentum $\mathbf{p}_a$ (7.104) is written in the form of the sum of the individual pulses in the entire section of the effect of the force of the nucleus $\mathbf{F}_a(t)$ as a function of time (or coordinates) from the origin of the effect t_0 on the orbital electron to the end of the effect t. Equation (7.104) can be presented in the integral form, although this is not important at the moment. The additional nuclear momentum $\mathbf{p}_a$ on the electron in the vicinity of the alternating shell of the proton nucleus is comparable with the nuclear forces as regards the magnitude and is determined by the effect of the vector of the strength $\mathbf{E}_a(t)$ of the alternating shell as the function of the coordinates presented with respect to time t

$$\mathbf{p}_a = \sum_{t_0}^{t} e\mathbf{E}_a(t)t \tag{7.105}$$

In the opposite case, the electron orbit should be situated in the same plane like the orbits of the planets, but the electron moves along a complicated trajectory generating the electron cloud around the nucleus from the trajectories situated in different planes. This again confirms that in the vicinity of the atomic nucleus the orbital electron is subjected to the effect of the additional nuclear momentum $\mathbf{p}_a$ (7.105) determined by the effect of the electrical field of the alternating shell of the proton nucleus (Fig. 7.4). Consequently, the plane of trajectory of the electron orbit changes by the angle φ_{1-2} (7.103).

It should be mentioned that the orbital angle φ_{1-2} (7.103) is of the statistical nature, both with respect to magnitude and direction. This is determined by the complicated configuration of the field of the alternating shell of the proton nucleus [7]. At the moment of approach to the surface of the proton nucleus which consists of the nodes of the alternating network, the electron interacts in a completely random manner with a large number of the nodes of the network and constantly changes the orbit plane. In the final analysis, we obtain an electron cloud around the atomic nucleus, even for a single orbital electron. Consequently, the scheme in Fig. 7.8 can be made more accurate for the case in which the orbit plane rotates in the vicinity of the proton nucleus. Figure 7.9 shows the rotation of the plane of the stationary orbit of the electron through the angle φ_{1-2} (a) and at the moment of radiation of the photon ν on the proton nucleus p of the atom (b) in transition from one orbit to another.

The effect of the structure of the nucleons of the atomic nucleus in the case in which the nucleons form a network of alternating fields on the surface of the nucleus causes that the behaviour of the orbital electron in the composition of the atoms greatly differs from its behaviour in the composition of the positronium (orthopositronium) in the absence of a similar network [18, 19]. For comparison, these are very useful models which enable us to analyse the behaviour of the electron in the composition of the atom and the positronium. It is not quite correct to assume that positronium is a hydrogen-like system because in positronium the role of the atomic nucleus appears to be played by the positron with a positive electrical charge, like the proton. However, the positron, in contrast to the proton, although it is the carrier of the electrical charge with positive polarity, does not have the alternating shell which gives the nuclear properties to the atom. In particular, the alternating shell determines the large mass of the nucleons and prevents

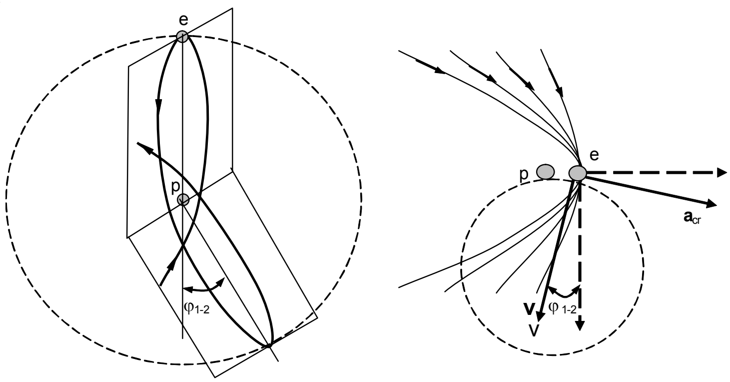

Fig. 7.9. Rotation of the plane of the stationary orbit of the electron through the angle φ_{1-2} (a) and at the moment of radiation of the photon ν on the proton nucleus *p* of the atom (b).

the orbital electron from falling on the atomic nucleus and determines the stability of atomic structure in contrast to the positronium.

Positronium does not have the properties of the atom because the positron does not have the properties of the atomic nucleus. The combined incidence of the electron on the positron, vice versa, results in two- or three-photon annihilation of the particles. The gravitational boundaries and the zones of anti-gravitational repulsion in the electron and the positron break open, resulting in their charges coming together to the distance smaller than the classic radius of the electron. It should be mentioned that the Superintegration theory supplements for the first time the reaction of annihilation of the electron and the positron by the appearance of the electron neutrino ν_e. We can write the two-photon reaction of annihilation with emission of 2γ gamma-quanta, denoting the electron and the positron as e_m^- and e_m^+ (index $_m$ indicates the presence of the mass in the particle, the index ± the presence of the electrical charge)

$$e_m^- + e_m^+ \to 2\gamma + e^- e^+ \to 2\gamma + \nu_e \qquad \text{where} \quad e^- e^+ \to \nu_e \tag{7.106}$$

The annihilation of reaction (7.106) shows that only the plus mass of the particles transfers into the emission of two gamma quanta 2γ. The charges form an electrical dipole $e^- e^+$ which is nothing else but the electron neutrino ν_e. In particular, the electrical dipole $e^- e^+$ is the elementary bit of information in vacuum according to which a pair of particles existed: the electron and the positron, fulfilling the law of conservation of information. On the whole, the electron neutrino carries the total latent energy of the electron and the positron ensuring that all the conservation laws are fulfilled [4].

The electron and the positron have the same mass but charges with opposite signs. Therefore, examining the positronium, it may be regarded as an electrical dipole and a gravitational dumbbell, formed by equivalent masses of the particles. In all likelihood, in rotation of the dumbbell the centrifugal forces acting on the mass of the particles are capable of preventing for a short period of time the electrical charges from rapidly coming together and determine the lifetime of the positronium. However, in any case, the electrostatic forces of the charges overcome the centrifugal forces and gravitation and lead to annihilation of the particles. In the final analysis, there is the combined incidence of the electron and the positron on each other. As shown by calculations, the speed of incidence of the particles at the annihilation distance is in the relativistic range. This is also in agreement with the assumption according to which the photon radiation, including gamma quanta, takes place at relativistic speeds. However, in contrast to the hydrogen atom, there are no mechanisms of stabilisation of the particle mass in the relativistic range of speeds working in the positronium atom and this may result in three-photon (or greater) radiation.

The instability of positronium stresses again that the stability of the simplest hydrogen atom is determined by the complicated structure of the proton nucleus. This relates to all atomic nuclei consisting of protons and neutrons. A shortcoming of all currently available atom theories is that the calculations were carried out taking into account only the electrical charge of the atomic nucleus which generates the radial electrical field, and the tangential component of the field of the alternating shell and the presence of the gravitational well at the nucleus were completely ignored. In this case, the hydrogen atom differs from the positronium only by the larger mass of the nucleus which does not explain the greatly differing properties of the hydrogen atom in comparison with positronium.

However, the properties of positronium and the hydrogen atom differ so much that they could be explained in the Superintegration theory only after discovering the structure of the elementary particles: electron, positron, nucleons, and also the structure of the atomic nucleus. As shown, as regards the physical nature the interaction between the electron the proton is not capable of causing annihilation of these particles. However, the interaction between the electron and positron cannot take place without their annihilation. For this reason, positronium is not capable of radiating low-energy photons like atomic structures.

In particular, the specific features of the structure of the atom nucleus determine not only its stability but also the emission of the orbital electron.

Figure 7.10 shows the moment of transition of the orbital electron ν e from the orbit 2 to the low stationary orbit 1 with the emission of a photon with a frequency ν at the moment of coming together with the proton nucleus *p*. It may be seen that the electron is transferred from the excited orbit 2 to the stationary orbit 1 only after emission of the photon by the orbital electron on the atomic nucleus. Consequently, the well-known assumptions of the quantum theory can be made more accurate. These assumptions state erroneously that the radiation by an electron takes place at the moment of transition of the electron from the excited to stationary orbit. The moment of radiation (coordinate and time) itself has not been accurately defined. The EQM theory states more accurately that the transition of the electron to the stationary orbit already takes place after radiation of the photon by the electron directly on the atom nucleus.

On the stationary orbit 1, the distance between the orbital electron and the proton constantly changes but the electron on the stationary orbit is not capable of radiation. For the electron to be capable of radiation, it must be transferred to the excited orbit. As already mentioned, the condition of radiation of the orbital electron on the atom nucleus is the acceleration of the electron $\mathbf{a}$ which must reach some critical acceleration $\mathbf{a} \geq \mathbf{a}_{cr}$ (7.83).

In the simplified classic form, the acceleration $\mathbf{a}$ and the direction of acceleration $\mathbf{n}_a$ of the orbital electron are determined by the variation of the speed $\mathbf{v}$ with time t during movement along a complicated orbital

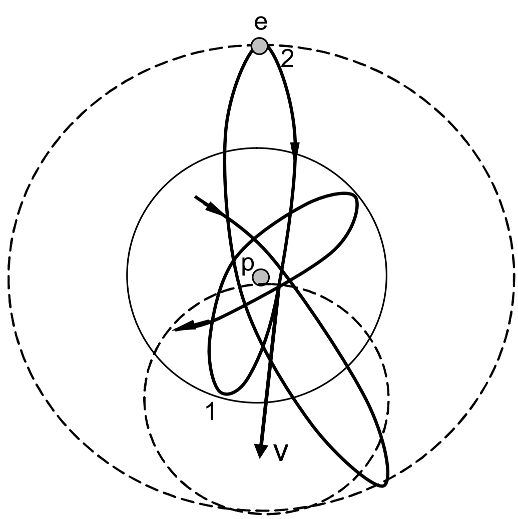

Fig. 7.10. The transition of the orbital electron *e* from the orbit 2 to the low stationary orbit 1 with the emission of a photon with frequency ν in the vicinity of the proton nucleus *p*.

trajectory:

$$\mathbf{a} = \frac{\partial v_x}{\partial x}\mathbf{i} + \frac{\partial v_y}{\partial y}\mathbf{j} + \frac{\partial v_z}{\partial z}\mathbf{k} \qquad (7.107)$$

$$a = \sqrt{\left(\frac{\partial v_x}{\partial x}\right)^2 + \left(\frac{\partial v_y}{\partial y}\right)^2 + \left(\frac{\partial v_z}{\partial z}\right)^2} \qquad (7.108)$$

$$\mathbf{n}_a = \frac{\mathbf{a}}{a} = \frac{\frac{\partial v_x}{\partial x}\mathbf{i} + \frac{\partial v_y}{\partial y}\mathbf{j} + \frac{\partial v_z}{\partial z}\mathbf{k}}{\sqrt{\left(\frac{\partial v_x}{\partial x}\right)^2 + \left(\frac{\partial v_y}{\partial y}\right)^2 + \left(\frac{\partial v_z}{\partial z}\right)^2}} \qquad (7.109)$$

Equation (7.107) reflects only the external side of the problem, treating acceleration as a metric and time parameter. However, the physical nature of acceleration is far deeper than that which can be measured by devices. In the final analysis, the nature of acceleration is associated with the additional redistribution of the quantum density of the medium inside the gravitational boundary of the particle, establishing the additional gradient of the quantum density of the medium in the direction of the effect of acceleration [2].

At the present moment, the modulus of critical acceleration a_{cr} can be determined approximately from the value of the Coulomb force F_e of interaction of the orbital electron with the proton atomic nucleus. It is taken into account that the atom is balanced from the viewpoint of energy and is a structure ensuring stabilisation of the rest mass of the electron m_e which does not depend on its speed on the orbit, even at speeds very close to the speed of light $v = C \leq C_0$ (1793). This enables us to determine the modulus of maximum acceleration $a_{\max}$ of the orbital electron at the distance $2r_e$ from the proton surface

$$a_{\max} = \pm\frac{F_e}{m_e} = \pm\frac{1}{4\pi\varepsilon_0}\frac{e^2}{(2r_e)^2 m_e}\frac{C_0^2}{C_0^2} = \frac{C_0^2}{4r_e} = \pm 0.8\cdot 10^{31}\,\text{m/s}^2 \qquad (7.110)$$

The sign (±) in (7.110) indicates that in the vicinity of the surface of the alternating shell of the proton the electron is subjected to both the attraction forces of positive charges and the repulsion forces of negative charges, situated in the nodes of the network of the alternating shell (Fig. 4). It should be mentioned that the expression (7.110) is acceptable only for the rough estimation of acceleration and force. The exact determination of these parameters is associated with solving a relatively complicated mathematical problem of determination of the functional dependence of the spherical distribution of the electrical potentials and the strength of the field of the alternating shell of the nucleon, both in the presence of the excess charge of positive polarity and total electrical neutrality of the shell.

In any case, even the approximate evaluation of acceleration a_{max} (7.110) shows that the orbital electron in the vicinity of the proton nucleus is subjected to the effect of colossal alternating acceleration. The alternating nature of acceleration in the range of relativistic speeds has a vibrational effect on the orbital electron and attempts to 'shakeout' the electrical charge of the electron from the gravitational field, alternately disrupting the spherically deformed quantised medium.

On the other hand, the trajectory of the orbital electron in the vicinity of the proton nucleus is distorted (Fig. 7.7, 7.8, 7.9, 7.10), and the minimum radius of distortion R_{min} is determined by the normal forces acting on the electron in the direction to the surface of the shell of the proton nucleus. These forces are comparable with the electrical force of attraction of the positive charge of the proton at the distance $2r_e$ from the proton surface and determine the identical acceleration a_{max} (7.110). Consequently, we can estimate the minimum radius R_{min} of distortion of the trajectory of the orbit of the electron in the region of relativistic speeds:

$$R_{min} = \frac{C_0^2}{a_{max}} = 4r_e = 1.13 \cdot 10^{-14}\,\text{m} \tag{7.111}$$

The stationary (first) orbit of the non-excited electron can be characterised by distance R_1 of the largest distance from the proton nucleus of the atom. Naturally, the limiting parameters of speed C_0, acceleration a_{max} (7.110) and radius R_{min} (7.111) cannot characterise the orbital electron in the first stationary orbit because the electron in the stationary orbit does not radiate and its acceleration a_1 in the vicinity of the proton nucleus always remains lower than critical acceleration a_{cr} (7.73) and a_{max} (7.110)

$$a_1 = \frac{C_1}{R_{1C}} < a_{cr} < a_{max} \tag{7.112}$$

Equation (7.112) includes the maximum relativistic speed $C_1<C_0$ of the orbital electron in the first stationary orbit and minimum radius R_{1C} of the distortion of the orbit in the vicinity of the proton nucleus on the condition that $R_{1C} > R_{min}$ (7.111). For the orbital electron to be capable of radiation, it must be transferred to the excited orbit. For example, in transition to the second orbit, with the maximum distance from the proton nucleus equal to R_2 the electron reaches the speed $C_2 < C_1$ in the vicinity of the proton nucleus, distorting the orbit on the radius R_{2C}. Since the excited electron is forced to radiate a photon on the proton nucleus, its acceleration a_2 should reach or exceed the critical value a_{cr} (7.73):

$$a_2 = \frac{C_2}{R_{2C}} > a_{cr} \tag{7.113}$$

Thus, the radiation of the orbital electron in transition from the second to the first orbit is associated with the variation of at least two parameters: relativistic speed of the electron C_2 and the radius R_{2C} of distortion of the trajectory of the orbit in the vicinity of the proton nucleus. This tendency is also maintained for subsequent orbits (3...*n*) of the electron and determines the number of unequal ratios:

$$\begin{gathered} a_n > \ldots > a_3 > a_2 > a_{cr} \\ \frac{C_n}{R_{nC}} > \ldots > \frac{C_3}{R_{3C}} > \frac{C_2}{R_{2C}} > a_{cr} \end{gathered} \tag{7.114}$$

where a_n, C_n, R_{nC} is the acceleration, the relativistic speed of the orbital electron and the radius of distortion of the orbit in the vicinity of the proton nucleus, respectively.

It appears that as the height of the orbit from which the electron falls on the proton increases, i.e., the distance (the radius vector) of the orbital electron from the atomic nucleus in the apogee, the acceleration of the electron in the vicinity of the proton nucleus also increases and the energy of the radiated photon becomes greater. However, as already mentioned, the behaviour of the orbital electron in the vicinity of the proton nucleus of the atom is affected by the random nature of interaction of the electron with the alternating shell of the nucleus which is a spontaneous disruption of the inequality (7.114). This may be expressed in the fact that in incidence on the nucleus, for example from the third orbit, the acceleration of the electron a_{3-2} may be lower than acceleration a_3, i.e. $a_{3-2} < a_3$ and the electron after emission of the photon transfer to the second orbit, remaining in the excited state. Subsequently, after emission of a photon, the electron transfer from the second to first stationary orbit.

Since the interaction of the orbital electron with the proton nucleus of the atom is of spontaneous nature, the orbital electron in changing three? The same orbit can emit every time photons of different energy on frequency, determining the spectral series of photon emission typical of a specific orbit.

Analysing the condition of emission of the orbital electron, i.e., critical acceleration a_{cr} (7.114), it is important to note that an increase of the relativistic speed of the orbital electron increases the radius of distortion of the orbit and determines by the ratio of the acceleration of the electron in the vicinity of the proton nucleus. For the electron to radiate, it is inserted to select the parameters of its relativistic speeds and radius of the orbit resulting in the fulfilment of the condition (7.114). However, since the increase of the relativistic speed of the orbital electron increases the radius of curvature of the orbit of the electron, the critical acceleration should be of discrete nature.

In fact, the increase of the relativistic speed of the orbital electron increases its acceleration. However, this is accompanied by a simultaneous increase of the radius of distortion of the orbital leading to a decrease of the acceleration of the orbital electron. In the final analysis, the orbital electron may reach the critical acceleration only discretely, determining the linear radiation spectrum.

If the orbital electron is investigated from the viewpoint of the theory of automatic regulation in movement of the electron to the regime in which is critical acceleration is reached followed by emission of a photon, this will be some vibrational wave process of transfer to the emission regime. However, this is a purely mathematical model. We can carry out special calculations which are well-known for the hydrogen atom, but this is not necessary. At the moment, it is important to show the physical role of critical acceleration a_{cr} of the orbital electron in irradiation of the linear spectrum when the wave transfer to the radiation regime determines the discrete nature of the radiation of the atom whose radiation energy ΔW is equivalent to the mass defect Δm_e (7.2) of the orbital electron

$$\Delta W = W_1 - W_2 = \hbar\nu = \Delta m_e C_0^2 \qquad (7.115)$$

where W_1 and W_2 is the electron energy prior to emission and after emission of a photon on the first and second orbit at the moment of emission on the atom nucleus, respectively.

In this book, we do not examine the problems of excitation of the orbital electron associated with an increase of its energy and mass in transition to a higher orbit at the moment of absorption of the external photon because this is a separate fundamental problem connected with the effect of the atom as a selective receiver of electromagnetic radiation.

It has not yet been possible to find the exact solution for critical acceleration a_{cr} of the electron because it is connected with the exact solution of the field of the alternating shell of the proton nucleus and a number of other parameters of the atom which is a relatively complicated mathematical problem. However, the problem has been formulated for the understandable physical model and its solution will definitely be found. In this stage of investigations we determine the limiting parameters of acceleration a_{max} (7.110). It is also important to present the physical models which would ensure the stability of the atom when the atom does not radiate, and the conditions of disruption of its stability at the moment of emission of the orbital electron. It should be noted that the investigated models of the atom inside the quantised medium and their analysis are in the initial stage of investigations and, naturally, time is required and new investigators are essential for the final development of mathematical facilities.

However, it is already clear that the quantum theory is governed by the deterministic analysis where the physical model of the atom capable of predicting the behaviour of the orbital electron is known. One can criticise incompleted studies and also difficulties which must be overcome in the development of new theoretical directions but they are not hidden and are convincingly presented as fundamental problems requiring serious attention.

It is important that the old considerations regarding quantum mechanics which resulted in colossal contradictions in the period of development and are associated with the quantum jumps inside the atom, have finally been overcome. It has been established that such quantum jumps of the orbital electrons simply do not exist in nature. Radiation of any orbital electron takes place only on the atomic nucleus when it reaches the speed of light or a speed close to this speed. After irradiation on the atomic nucleus, the electron is transferred smoothly without any jump to a lower orbit (Fig. 7.10).

In this book, it is important to show all the factors considered by the new model of the atom taking into account the alternating shell of the nucleons and the presence of the gravitational well around the atom nucleus inside which the orbital electron rotates. We have mentioned a list of tasks which must be solved in order to derive the total equation of dynamics of the orbital electron and determine its possible orbit trajectories, describing the electronic cloud. Evidently, the analytical solution of the given problem with all the given factors taken into account are difficult to obtain by the numerical solutions realistic using computing methods. Consequently, it may be asserted that quantum physics will become deterministic sending to history the principle of uncertainty since the equations of dynamics of the orbital electron and the form of its trajectory enable us to know both the coordinate on the trajectory and the electron momentum.

The analysis shows that the photon radiation of the orbital electron in the composition of the atom is possible only as a result of the mass defect of the electron in the range of relativistic speeds when the electron is situated in the immediate vicinity of the atom nucleus in the field of critical acceleration causing separation of part of the electron mass whose elastic energy is transferred into photon radiation.

7.6. The role of superstrong interaction in photon radiation

As already mentioned, the emission of the orbital electron is associated with transformation of its mass defect to electromagnetic photon radiation. The mass defect of the electron represents part of the energy of its spherical deformed gravitational field. This is the elastic energy of deformation of the quantised medium. Thus, the problem of radiation of the orbital electron is reduced to the transformation of the static gravitation to dynamic electromagnetism. However, to be completely accurate, then it should be said that the static gravitational field in the form of the spherically deformed quantised medium for the moving electron is instantaneous, fixed at the given moment of time because in the next moment of time the electron transfers to the next local region of the quantised medium in relation to the stationary quantised space-time. This is the wave transfer of electron mass in the space having the form of wave transfer in the medium of its gravitational field [2, 4].

Prior to the development of the EQM theory, it was assumed that the source of photon radiation of the atom is the variation of its electrical component which generates the electromagnetic radiation in accordance with the Maxwell equations. This approach to the problem is natural from the viewpoint of the history of the development of the theory of electromagnetism because there was no other explanation of the nature of photon radiation. On the other hand, this approach was contradicted by the Maxwell equations according to which the atom should continuously radiate energy because of the continuous variation of the electrical field between the orbital electron and the atomic nucleus. In the final analysis, the electron should fall on the nucleus. However, the atom has proved to be a stable system emitting energy in portions, also in the excited state, and the orbital electron does not fall on the nucleus. Photon radiation is not associated with the change of the electrical component and is linked with the mass defect (7.114) of the orbital electron at the moment of its radiation on the nucleus.

At the present time, the theory of electromagnetism contains a distinctive and understandable mechanism of excitation of the electromagnetic wave by the electromagnetic masses and has absolutely no mechanism of excitation of photon radiation as a result of the mass defect of the elementary particle, with the exception of postulating the principle of equivalence of mass and energy. In [1] the nature of the electromagnetic wave was described and the Maxwell equations were derived for the first time analytically as a result of electromagnetic polarisation of the quanton and a group of quantons. Electromagnetic perturbation is regarded as a disruption of electromagnetic equilibrium of the quantised medium which is the carrier of superstrong electromagnetic interaction (SEI).

In [3], the two-rotor structure of the photon is described and it is shown that the photon is a specific electromagnetic wave whose formation takes place only in the range of relativistic speeds. The photon is a relativistic particle. To radiate a photon, the orbital electron should be accelerated to a speed close to the speed of light. In [3] this asumption is in complete agreement with the results of investigations described in this book.

In [2] the authors describe the nature of gravitational perturbation of the quantised medium which is also based on the superstrong electromagnetic interaction. The difference between electromagnetism and gravitation in the quantised medium can be expressed through the displacement of electrical Δx and magnetic Δy charges in the quanton [2]

$$\Delta x = \pm \Delta y \tag{7.116}$$

The sign (+) in (7.116) corresponds to gravitational interactions in the quantised medium. The quantum density of the medium changes as a result of its spherical deformation in compression and tension. The sign (–) in (7.116) determines the electromagnetic interaction through the polarisation of the quantised medium where the quantum density of the medium remains constant.

The mechanism of the transfer of the mass defect to electromagnetic perturbation is associated with the substitution of the sign (+) by the sign (–) in equation (7.115). This substitution of the sign determines the transition of the energy of elastic deformation of the quantised medium to the energy of its electromagnetic polarisation. It is now necessary to examine specific physical models which enable the orbital electron to fragment the energy of elastic deformation of the quantised medium followed by its transformation into photon emission.

Figure 7.11 shows the simplified scheme of elastic separation of part of the mass m_e of the orbital electron under the effect of critical acceleration $\geq \mathbf{a}_{cr}$ in the region of relativistic speeds as a result of disruption of the spherical symmetry of the gravitational field of the electron. Prior to emission of the photon, the orbital electron 1 is represented by its gravitational boundary with radius r_e. After emission of the photon on the proton nucleus p, the radius of the gravitational boundary 2 of the orbital electron e decreases by the value Δr_e thus determining the value of the mass defect Δm_e and the energy of photon emission. The point electrical charge 3 inside

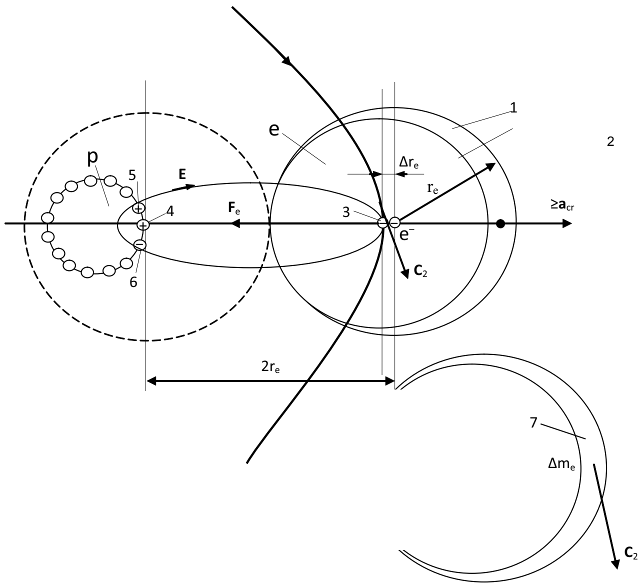

Fig. 7.11. Scheme of elastic separation of part of mass Δm_e of the orbital electron under the effect of critical acceleration $>a_{cr}$ as a result of the disruption of the spherical symmetry of the gravitational field of the electron.

the electron is displaced by the distance Δr_e in the direction of the proton.

We examine in greater detail the processes taking place during the interaction of the proton nucleus *p* and the orbital electron *e* at the moment of emission of the photon. Proton *p* has the alternating shell, including the excess electrical charge 4 with positive polarity. Coulomb attraction forces act between the charge 4 of the proton and the charge 3 of the orbital electron. These forces displace the charge 3 by the distance Δr_e from the centre of the electron 1, disrupting its spherical symmetry even prior to photon emission.

On the other hand, the orbital electron is subjected to the effect of the centrifugal force determined by critical acceleration $\geq \mathbf{a}_{cr}$. This force acts selectively only on the electron mass m_e which is represented by the elastic energy of the spherical deformation of the quantised medium. The centrifugal forces do not affect the electrical charge 3 of the electron because these forces are connected only with the gravitational interactions.

As already mentioned, the scheme in Fig. 7.11 is simplified because the electron mass is determined by its gravitational well (Fig. 7.1) which is found on the external side of the gravitational boundary, and in Fig. 7.11 the electron is represented by the internal region. This is not of great importance because the displacement of the electrical charge 3 of the electron over the distance Δr_e inside the gravitational boundary relates to such displacement in relation to the spherically symmetric centre of the gravitational well. Therefore, all the considerations relating to the analysis of the mass defect of the electron are connected with the displacement of the charge in relation to its spherical gravitational boundary. This is also convenient for graphical representation because it does not overload the figure with unnecessary details.

Thus, the charge of the electron 3 is subjected to the effect of the electrical force which tries to move the charge in the direction of the proton. The mass of the electron 1 and the form of the spherically deformed region of the quantised medium is subjected to the effect of centrifugal acceleration with the force directed in the opposite direction. The electrical and centrifugal forces try to disrupt the spherical symmetry of the electron.

However, in the quantised medium the electron is subjected to another additional tension forces of the medium determined by superstrong interaction (SEI). In particular, the colossal tensions of the quantised medium determine the conditions of stability of the gravitational boundary of the electron only if it is spherically symmetrical. If the spherical symmetry of the electron is disrupted above the critical threshold, the tension forces of the medium automatically restore the spherical symmetry of the electron, releasing its asymmetric part into radiation through the mass defect Δm_e. Thus, the role of SEI is fundamental in ensuring the principle of spherical invariance in the quantised medium. Without the effect of SEI the orbital electron could not emit energy in portions.

Figure 7.11 shows the moment of separation of the mass Δm_e of the asymmetric part 7 of the electron which, because of inertia, continues to move in the direction of the vector of instantaneous speed $\mathbf{C}_2$ at the moment of separation. Speed $\mathbf{C}_2$ corresponds to the instantaneous speed of the state of the electron on the second orbit. After separation of the asymmetric part, the electron is subjected to the effect of the recoil momentum $\Delta m_e C_2$ in the reversed direction and its speed decreases to the instantaneous speed C_1 determined by the condition of the balance of the amount of motion

$$\Delta m_e C_2 = m_e(C_2 - C_1), \quad \text{from which} \quad C_1 = C_2\left(1 - \frac{\Delta m_e}{m_e}\right) \quad (7.117).$$

Regardless of the fact that all the speeds in (7.117) are relativistic, the solutions are very simple because the atom, being the energy-balanced system, ensures the constant mass of the orbital electron, including in the relativistic speed range. The mass defect of the orbital electron is not connected with the relativistic conditions of the possible increase (decrease) of the mass. The consequence of these actions with the orbital electron when its asymmetric part 7 becomes separated is the transition of the electron to the first stationary orbit. On the first stationary orbit the atom maintains the constant mass of the electron, corresponding only to this orbit.

As already mentioned, the alternating shell of the proton has many noteworthy properties, including the fact that it may provide an additional momentum for the electron as a result of the effect of the tangential component of the electrical field of the shell. We separate two energy-balanced charges 5 and 6 (Fig. 7.11) of the shell whose electrical field **E** in the form of a closed line of force extends to the orbital electron 3, acting on it by its tangential component. This may supply to the orbital electron a very small amount of energy which compensates radiation (7.68) and at the same time provides an additional momentum to the electron and determines the stability of its stationary orbit. It is not clear how the synchronisation of the movement of the electron with the moment of the effect of the additional momentum in the direction of its speed takes place. Possibly, movement of the electron on the stationary orbit is in agreement with the effect of the principle of auto-phasing. The nature of the latter must be determined.

In any case, after separation of the asymmetric part 7 the electron remains in the stationary orbit and does not emit the photon. To provide more information, the asymmetric part 7 in Fig. 7.11 is separated from the electron in the form of its mass defect Δm_e. It may be assumed that the process of transformation of the asymmetric part 7 to electromagnetic radiation takes place in fact on the electron itself. Asymmetric part 7 is the elastically deformed part of the quantised medium and its deformation energy determines the mass defect of the electron Δm_e. Now, when this elastic energy of the quantised medium is not connected with the electron, it is similar to a spring trying to release its gravitational energy.

Since the released energy of elastic deformation relates to the energy of the gravitational field, it should be suggested that it generates a momentum of the gravitational wave [20, 21]. In fact, gravitational energy is transformed into photon radiation which is of the electromagnetic nature. This transformation can take place as a result of the capacity of the quantised medium for self-organisation when the release of the gravitational energy of elastic deformation of the quantised medium as a result of superstrong electromagnetic interaction causes transverse oscillations of the charges inside the quantons. Consequently, the electrical and magnetic bias currents form in the medium. In the range of relativistic speeds the electrical and magnetic bias currents of the charges cause self-organisation of the two-rotor structure of the photon. However, the photon has also the longitudinal component of the bias currents [3].

Figure 7.12 shows the scheme of the two-rotor structure of the low-energy photon emitted by the orbital electron (the structure of the photon was described in detail in [3]). Now it is important to mention that the two-rotor structure of the photon can form only as a result of the mass defect of the orbital electron in the range of relativistic speeds. The wavelength of photon emission determines the photon diameter. In the case of the high-energy photons, a decrease of the photon diameter increases the cross-section of the rotors ensuring the strong dependence of the energy of electromagnetic polarisation of the quantised medium by the photon on the radiation frequency. With increasing frequency the rotors of the high-energy photon seem to 'bulge' [3].

It is necessary to mention, albeit briefly, the mechanism of photon emission in nuclear fission and synthesis reactions. Like the mechanism of emission of the photon by the orbital electron in the composition of the atom, the mechanism of photon emission in nuclear reactions is also determined by the mass defect of the atomic nucleus, more accurately, the nucleons in the composition of the nucleus. This is a fact. Another condition of photon radiation by the orbital electron is that the electron forms the photon in the range of relativistic speeds, i.e., speeds close to the speed of light. Is this condition compulsory in the formation of photon emission in nuclear actions which at first sight appear not connected with the relativism?

This question receives a positive answer, assuming that in the fission reactions the process of 'rolling-up' of new nuclei in the region of strong interactions is so fast that the 'rolling-up' of the nucleons into a new, albeit smaller nucleus, takes place with a high speed, possibly close to the speed of light. Regardless of the short duration of the process, this may proved to

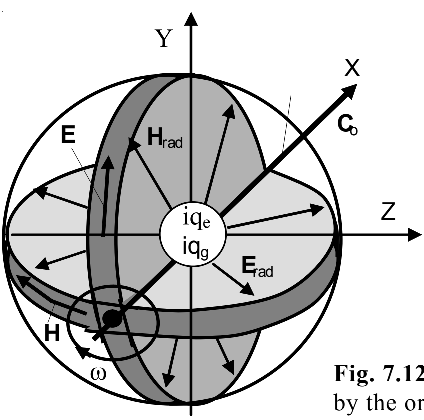

Fig. 7.12. The two-rotor structure of the photon emitted by the orbital electron.

be sufficient for separating the photon as a result of the mass defect of the nucleus. Although it is fully possible that as a result of the mass defect of the nucleons the elastic energy of deformation of the quantised medium is, as a result of self-organisation, capable of creating the two-rotor photon structure at lower speeds. However, these assumptions require confirmation by additional theoretical investigations.

It is fully realistic to reach relativistic speeds in synthesis reactions. In a thermonuclear bomb, the merger of the proton–neutron nuclei is associated with their preliminary acceleration as a result of a detonation nuclear explosion followed by deceleration during fusion of the nuclei. The detonation nuclear explosion causes acceleration and forces sufficient for overcoming the electrostatic repulsion of the proton charges and at the same time the photons reach relativistic speeds. The attempts for inducing controlled thermonuclear synthesis only by heating plasma to superhighs temperature evidently did not take into account these additional factors which determine the occurrence of the thermonuclear reaction with the generation of photon radiation energy.

7.7. Gravitational radiation of the atom

In order to understand better the reasons for the transformation of gravitational energy to electromagnetic photon radiation, it is necessary to describe more accurately the main differences between gravitational and electromagnetic radiation. The views existing in physics regarding the gravitational waves are erroneous because they assume that the nature of the gravitational wave, like the nature of the electromagnetic wave, should be based on the transverse oscillations of space-time. This has not been confirmed by experiments. Intensive research to find transverse gravitational waves over many decades have been unsuccessful and have no future. As shown in the EQM theory, only the bias currents in the electromagnetic waves are characterised by transverse oscillations [1].

After discovering the superstrong electromagnetic interaction (SEI) when the structure of the quantised space-time was determined, the nature of gravitational waves as the waves of longitudinal oscillations in the quantised medium similar to acoustic waves was investigated in [20, 21]. The quantised space-time resembles more a solid because of the colossal tensions of the quantised medium and dense packing of the quantons in the ordered structure with the highest quantum density, being the carrier of SEI [1]. This medium can contain both transverse electromagnetic wave perturbations and longitudinal gravitational perturbations which in the final analysis are electromagnetic and associated with the disruption of gravitational equilibrium of the superstrong electromagnetic interaction.

In an ideal case, the source of the gravitational wave can be periodic deformation of the quantised medium causing longitudinal oscillations in the medium as a result of periodic changes of mass m, for example, in accordance with the harmonic law with the cyclic frequency ω in relation to the amplitude value of the mass m_a

$$m = m_a \sin \omega t \tag{7.118}$$

A source with parameters (7.118) of a continuous gravitational perturbation would be ideal, but its realisation is associated with the periodic transfer of the plus mass and the minus mass and vice versa. These changes of mass in space lead to longitudinal oscillations of the quantised medium which are described by the wave equation, like equation (7.80), replacing the speed v by the speed of propagation of the gravitational wave C_0:

$$\frac{\partial^2 \rho}{\partial t^2} = C_o^2 \left(\frac{\partial^2 \rho}{\partial x^2} + \frac{\partial^2 \rho}{\partial y^2} + \frac{\partial^2 \rho}{\partial z^2} \right) \tag{7.119}$$

or

$$\frac{\partial^2 \rho}{\partial t^2} = C_0^2 \left(\frac{\partial D}{\partial x}\mathbf{i} + \frac{\partial D}{\partial y}\mathbf{j} + \frac{\partial D}{\partial z}\mathbf{k} \right) \tag{7.120}$$

The solutions of the equations (7.119) and (7.120) are periodic changes of the quantum density of the medium and its deformation D in relation to the amplitude values ρ_a and D_a, respectively, and also for the spherical gravitational wave

$$\rho = \rho_o - \rho_a \sin \omega t \tag{7.121}$$

$$\mathbf{D} = \mathbf{D}_a \sin \omega t \tag{7.122}$$

The deformation vector **D** (7.122) of the quantised medium is longitudinal and oscillate in the direction of propagation of the gravitational wave and determines the direction of the vector of its speed $\mathbf{C}_0$.

Naturally, the atom cannot realise the ideal case of gravitational radiation. However, the atom is capable of continuous gravitational radiation. Previously, we investigated the case in which the atom carries out, as a result of the rotation of the orbital electron inside the gravitational well of the nucleus, very small periodic changes of gravitational energy with the amplitude $\Delta W_0 = 1.1 \cdot 10^{-36}$ eV (7.68). It was shown that the nature of this radiation is not yet known. However, analysis of the small change in the mass of the orbital electron inside the gravitation well of the nucleus shows that gravitational radiation may take place in this case because the periodic changes of the mass generate longitudinal oscillations of the quantised medium.

Actually, moving inside the gravitation well closer to the proton nucleus, the orbital electron is found in the region of the gravitational potential of action C which is lower lower than the equilibrium potential C_0 of the non-perturbed quantised medium. However, the gravitational potential in particular determines the electron energy and, correspondingly, its mass, whose variation Δm_0 is associated with the variation of energy ΔW_0 (7.68)

$$\Delta m_e = \frac{\Delta W_0}{C_0^2} = m_e\left(1 - \frac{C^2}{C_0^2}\right) = \frac{Gm_e m_p}{2r_e C_0^2} = \frac{1}{2} m_p \frac{R_e}{r_e} = 2 \cdot 10^{-70}\,\text{kg} \quad (7.123)$$

The periodic continuous radiation of the mass (7.123) of the orbital electron is extremely small but it does take place during the movement of the electron along a complicated trajectory. Naturally, the recording of the gravitational radiation generated during this process is outside the sensitivity of the currently available measuring systems. To obtain the energy of gravitational radiation of only 1 eV it is necessary to combine the energy of the order of 10^{36} (68) orbital electrons. If we consider the heavy nuclei of the atoms in which the depth of the gravitational well may be $\sim 10^2$ times greater than the proton well, and photons of at least ten orbital electrons in the atoms are emitted synchronously and in phase, the mass of the active part of such a gravitational emitter is of the order of 10^6 kg with the radiation energy of 1 eV. Therefore, the construction of generators of gravitational waves is connected with the simultaneous effect of strong magnetic and electrical fields on the active part of the emitter [20, 21]. In this case, we should consider the formation of a new direction in quantum electronics associated with the development of gravitational generators (grazers) (not to be confused with lasers – quantum generators of gamma radiation).

On the other hand, investigations of even very weak continuous gravitational signals emitted by the orbital electrons would make it possible to determine the nature of periodicity of the signals in the form of a specific functional dependence which is naturally connected with the nature of movement of the electron along the trajectory inside the atom. This means that in future it would be possible to investigate the functional dependences of the trajectories of the orbital electrons regardless of their complexity.

10 .8. Probability electronic cloud

The deterministic nature of the behaviour of the orbital electron in the atom, regardless of its complicated trajectory, makes it possible to explain the reasons for the application in physics of the probability parameters in quantum mechanics when the structure of the electron, the proton, the neutron, the photon, the atomic nucleus and the quantised space-time was not known. Einstein was right when he said that the 'God does not throw the dice'.

Figure 7.13 shows the calculation model (Fig. 7.8) of the greatly elongated orbit of the orbital electron. The coordinates *X–Y* have been added. Taking into account the fact that the orbital electron *e* carries out periodic oscillations around the proton nucleus *p* of the simplest atom along the greatly elongated orbit, we can approximate the projection of its orbit, for example, on the *Y* axis by the harmonic function, fixing the deflection of the electron *y* from the proton nucleus:

$$y = A_e \cdot \sin \omega t \tag{7.124}$$

here is A_e is the amplitude of deflection of the electron from the proton nucleus, *m*; ωt is the cyclic frequency of oscillations of the electron

$$\omega t = \frac{2\pi}{T} t \tag{7.125}$$

here T is the period of rotation of the electron on the orbit, s.

In accordance with (7.124) at the moment of time $t = 0$ $y = 0$ and the electron is situated in the immediate vicinity of the proton nucleus.

The counting of time t is determined by the deflection y (7.124) of the electron from the origin of the coordinates

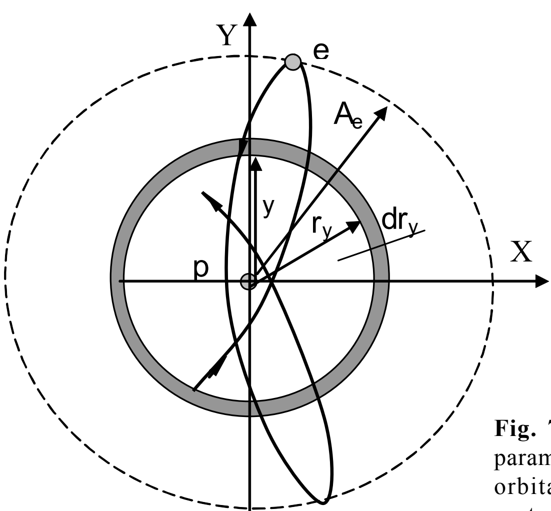

Fig. 7.13. Calculation of probability parametersof the electron cloud of the orbital electron *e* in relation to the proton nucleus *p* of the atom.

$$t = \frac{T}{2\pi} \arcsin \frac{y}{A_y} \tag{7.126}$$

The projection of the speed of the electron v_y is expressed by the first derivative with respect to time t from (7.124)

$$v_y = \frac{\partial\, y}{\partial\, t} = -\omega A_e \cos \omega t \tag{7.127}$$

The maximum speed of the electron is in the vicinity of the nucleus. Evidently, the probability of detection of the electron in the vicinity of the atom nucleus is minimum and on the surface of the nucleus it is reduced to 0.

The orbital electron, describing a spherical rosette around the nucleus, occupies a specific volume (Fig. 7.8b) with the radius A_e, and the equation (7.124) describes the electron cloud linking the deflection y (7.124) with the radius r_y of the specific layer of the cloud, $y = r_y$ (Fig. 7.13).

We separate an arbitrary spherical volume dV_y of the electron cloud with a radius r_y and thickness dr_y (Fig. 7.13):

$$dV_y = 4\pi r_y^2 dr_y \tag{7.128}$$

In wave mechanics, 1 (7.4) is the probability of the electron located in the total volume of the cloud, integrating the square of the wave function over the entire volume. The problem is simplified if the condition (7.124) is used. In this case, the probability dp_v of the electron being in some spherical volume of the cloud is proportional to the time dt required by the electron to pass through the thickness dr_y of the cloud:

$$dp_v = f(y)dt \tag{7.139}$$

here $f(y)$ is the function of the cloud which is to be determined.

Evidently, the probability equal to 1 is determined by the integral with respect to time in movement of the electron in the section equal to A_y which the electron passes in a quarter of the period $T/4$

$$\int_0^{T/4} f(y)dt = 1 \tag{7.140}$$

As a result of analysis of the duration of passage of the layers of the electron cloud by the electron, it can be seen that the probability p_v of the electron situated in a specific layer of the cloud is determined by the ratio of the time t, required to pass through the layer, to $T/4$, and taking into account the function (7.126) we obtain

$$p_v = 4\frac{t}{T} = \frac{2}{\pi}\arcsin\frac{y}{A_y} \qquad (7.131)$$

Verification of (7.131) shows that when the electron passes through the entire volume of the electron cloud at $y = A_y$, the probability of the electron being located in the cloud is equal to 1, since arcsin 1 = $\pi/2$.

The probability function (7.131) can be used to determine the probability of the electron beam in the layer of the electron cloud at different ratios y/A_y away from the nucleus.

Table 7.1. Probability p_v of the orbital electron of being in the layer of the electron cloud

y/A_y	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
p_v	0	0.064	0.13	0.194	0.262	0.333	0.41	0.49	0.59	0.71	1.0

As indicated by Table 7.1, the probability of the orbital electron being on the surface of the atomic nucleus is almost 0. In the vicinity of the atomic nucleus the probability is minimum and starts to increase slowly with the increase of the distance, rapidly increases at the periphery of the electron cloud. This is in agreement with the experimental results.

Naturally, in this case, we consider the method of calculating the probability of finding the orbital electron (and not the accuracy of the method) which requires serious corrections because of the assumptions made. The determination of the exact function for the trajectory of the orbital electron taking a large number of factors into account, presented in the chapters of this book, requires extensive and time-consuming computations.

Most importantly, it has been shown for the first time that the probability methods in quantum mechanics have a fully determined base, as insisted by Einstein.

7.9. Conclusion

The discovery of the quantised structure of the electron, as the compound part of the quantised space-time in the Superintegration theory, shows that its radiation is associated with its mass defect.

It has been shown for the first time that the orbital electron has a complicated orbit, rotating inside the gravitational well of the atomic nucleus. In particular, this factor is stabilising and ensures the constancy of the electron energy on approach to the nucleus when the increase of the electrical component is fully compensated by the decrease of the gravitational energy of the system as a whole.

Has been shown that the radiation of the orbital electron takes place at speeds close to the speed of light by synchrotron radiation which takes place when the centrifugal critical acceleration is reached. The electron is not capable of maintaining the spherical symmetry of the deformed quantised space-time which forms its mass, and part of the deformation energy, which has been lost, is transferred to the energy of photon emission.

It has been shown that the reason for the probability electron cloud of the orbital electron inside the atom has a fully determined base and is associated with special features of the trajectory of the electron.

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